GeoScience Abstracts

3-1030 TO 3-1381

Vol. 3, No. 4 April 1961

published monthly by the
AMERICAN GEOLOGICAL INSTITUTE

GEOSCIENCE ABSTRACTS

published by the
American Geological Institute

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GeoScience Abstracts is published monthly, beginning with Volume 1, Number 1, January 1959, and replaces Geological Abstracts which was discontinued by the Geological Society of America at the end of 1958. The journal has received a grant in aid from the National Science Foundation to provide initial working funds.

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GeoScience Abstracts

published monthly by the
AMERICAN GEOLOGICAL INSTITUTE

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Akademiya Nauk SSSR, Izvestiya, Geophysics Series, in English translation (American Geophysical Union). New York.
Alberta Society of Petroleum Geologists, Journal. Calgary.
American Association of Petroleum Geologists, Bulletin. Tulsa, Oklahoma.
American Geophysical Union, Transactions. Washington, D.C.
American Journal of Science. New Haven, Connecticut.
American Museum of Natural History, American Museum Novitates. New York.
American Philosophical Society, Transactions. Philadelphia.
California, Dept. of Water Resources, Bulletin. [Sacramento?].
Canada, Dept. of Mines and Technical Surveys, Geographical Branch, Geographical Paper, Ottawa.
Canada, Geological Survey, Map; Memoir; Paper. Ottawa.
Canadian Mining and Metallurgical Bulletin. Montreal.
Canadian Mining Journal. Gardenvale, Quebec.
Chicago, Natural History Museum, Fieldiana: Geology.
Deep-Sea Research. London-New York.
Ecology (Ecological Society of America). Durham, North Carolina.
Engineering Journal. Montreal.
Gems and Minerals. Mentone, California.
Geochimica et Cosmochimica Acta. London-New York.
Geological Society of America, Bulletin; Memoir. New York.
Illinois State Water Survey, Bulletin; Report of Investigation. Urbana.
International Geology Review (American Geological Institute). Washington, D.C.
Journal of Sedimentary Petrology. Tulsa, Oklahoma.
Kansas, University, Paleontological Contributions. Lawrence, Kansas.
Micropaleontology (American Museum of Natural History). New York.
Mineral Industries (Pennsylvania State University, College of Mineral Industries). University Park, Pennsylvania.
National Academy of Sciences, IGY Bulletin; Proceedings. Washington, D.C.
National Advisory Committee on Research in the Geological Sciences, Ottawa, Annual Report.
New York Times. New York.
North Dakota, Geological Survey, Biennial Report. Grand Forks.
Ohio, Division of Geological Survey, Bulletin; Report of Investigations. Columbus.
Ohio, Journal of Science. Columbus.
Oklahoma Geological Survey, Guide Book. Norman.
Oklahoma Geology Notes (Oklahoma Geological Survey). Norman.
Ontario, Dept. of Mines, Preliminary Map; Preliminary Report. Toronto.
Pennsylvania Geological Survey, Progress Report. Harrisburg.
Photogrammetric Engineering (American Society of Photogrammetry). Washington, D.C.
Quebec (Province), Dept. of Mines, Geological Report; Preliminary Report. Quebec.
RAND Corporation, Research Memorandum. Santa Monica, California.
Rocks and Minerals. Peekskill, New York.
Science. Washington, D.C.
Seismological Society of America, Bulletin. Berkeley, California.
Shale Shaker (Oklahoma City Geological Society). Oklahoma City, Oklahoma.
South Dakota, State Geological Survey, Biennial Report; Geologic Quadrangle Map Series. Vermillion.
Texas Journal of Science. Austin.
U.S. Army, Corps of Engineers, Committee on Tidal Hydraulics, Technical Bulletin. Vicksburg, Mississippi.
U.S. Bureau of Mines, Bulletin; Information Circular; Report of Investigations. Washington, D.C.
U.S. Geological Survey, Bulletin; Circular; Geologic Quadrangle Map; Mineral Investigations Map; Oil and Gas Investigations Map; Professional Paper; Reports, Open-File Series. Washington, D.C.
Virginia, Division of Mineral Resources, Bulletin. Charlottesville.
Washington, Division of Water Resources, Water Supply Bulletin. Olympia.
West Virginia Geological and Economic Survey, Bulletin; Educational Series; Report of Investigations. Morgantown.

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1. GEOLOGIC MAPS, AREAL AND REGIONAL GEOLOGY

PART 1. GEOLOGIC MAPS

See also: Areal and Regional Geology 3-1058 through 3-1063, 3-1067, 3-1069, 3-1074; Geomorphology 3-1086, 3-1087, 3-1088; Mineral Deposits 3-1349; Fuels 3-1362, 3-1363.

3-1030. Kelley, D.G. GEOLOGY, ST. ANN'S, VICTORIA AND INVERNESS COUNTIES, CAPE BRETON ISLAND, NOVA SCOTIA: Canada, Geol. Survey, Map 38-1960, scale 1:63,360, descriptive notes, 1960, 5 refs.

Preliminary map, covering approximately 400 sq. mi. in the Cape Breton highlands, about 30 mi. NE. of Sydney. The oldest rocks of the area are Precambrian quartzite, quartz-feldspar gneiss, sericite, biotite, chlorite schists, minor limestone, amphibolite, and silicic volcanic rocks. Diorite and quartz diorite are the oldest known igneous rocks in the area. Following the diorite are gneisses which are at least in part, foliated equivalents of the dioritic rocks. The granitic rocks are divided into granite, granite and porphyroblastic granite, and granite gneiss and are probably Devonian in age. Areas of mixed rocks consist of an accumulation of the above-mentioned rocks, but are predominantly sedimentary units. Pre-Mississippian andesites, basalts, and rhyolites are unmetamorphosed rocks that overlie the older rocks unconformably. Gabbro and diorite dikes are very common. The Horton group conglomerate, sandstone, and siltstone are conformably overlain by the Mississippian Windsor group in limestone, gypsum, and siltstone. Two periods of deformation are indicated: 1) folding, metamorphism, and intrusion probably during Devonian time; 2) folding of the volcanic and Mississippian rocks. Small amounts of galena; chalcopyrite; copper, lead, zinc, and silver sulfides; pyrite; nickeliferous pyrrhotite; and specularite occur. Gypsum has been quarried, but production ceased in 1916.--M. Stewart.

3-1031. Ontario, Dept. of Mines. BALMER TOWNSHIP, PART OF WEST HALF: Its: Prelim. Map P. 94, scale 1 in. to 500 ft., 1960.

Accompanying this preliminary geologic map and the map of Dome Township (see abstract immediately below) is a legend sheet.

3-1032. Ontario, Dept. of Mines. DOME TOWNSHIP, PART OF EAST HALF: Its: Prelim. Map P. 93, scale 1 in. to 500 ft., 1960.

3-1033. Trumbull, James. COAL FIELDS OF THE UNITED STATES [SHEET 1]: scale 1:5,000,000, Washington, D.C., U.S. Geological Survey, 1959, pub. 1960.

Areas underlain by coal are shown on a 25 by 39 in. map of the United States by colors indicating rank; coking coal mining areas are also shown. Four small maps show reserves and production by states, geologic age of coals, and coal-producing districts. Two charts explain rank classification and compare heat values with approximate analyses. Selected references to reports on coal occurrence are listed. Coal fields of Alaska will be shown on sheet 2, which is in press.--U.S. Geol. Survey.

3-1034. Dibblee, Thomas W., Jr. GEOLOGIC MAP OF THE LANCASTER QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA: U.S. Geol. Survey, Mineral Inv. Map MF-76, scale 1:62,500, lat. 34°30'-34°45'N., long 118°-118°15'W., 1960, pub. 1961.

3-1035. Colton, Roger B. SURFICIAL GEOLOGY OF THE WINDSOR LOCKS QUADRANGLE, CONNECTICUT: U.S. Geol. Survey, Geol. Quad. Map GQ-137, scale 1:24,000, lat. 41°52'30"-42°N., long. 72°37'30"-72°45'W., 1960, pub. 1961.

Glacial deposits in the Windsor Locks quadrangle include till, outwash, ice-contact stratified drift, varved lake deposits, undifferentiated lake deposits, deltaic deposits, and beach deposits. Postglacial deposits include talus, terrace deposits, swamp deposits, sand dunes, other eolian deposits, landslide deposits, and alluvium. Large deposits of artificial fill have been made in the area. Ice-contact stratified drift, varved clay, deltaic deposits, beach deposits, and talus are of commercial importance.--U.S. Geol. Survey.

3-1036. Goldsmith, Richard. SURFICIAL GEOLOGY OF THE UNCASVILLE QUADRANGLE, CONNECTICUT: U.S. Geol. Survey, Geol. Quad. Map GQ-138, scale 1:24,000, lat. 41°22'30"-41°30'N., long. 72°-72°07'30"W., 1960, pub. 1961.

The surficial deposits consist mostly of ground moraine and stratified drift of late Pleistocene age. The glacial stream deposits are shingled from S. to N. and were deposited by streams graded from a northerly retreating source. Profiles of the glacial stream deposits are figured. One and possibly 2 southeastward-trending temporary ice fronts crossed the quadrangle. Their former positions are marked by patches of end moraine, linear boulder accumulations, and alignment of heads of valley trains.--U.S. Geol. Survey.

3-1037. Becraft, George E. PRELIMINARY GEOLOGIC MAP OF THE NORTHERN HALF OF THE JEFFERSON CITY QUADRANGLE, JEFFERSON AND LEWIS AND CLARK COUNTIES, MONTANA: U.S. Geol. Survey, Mineral Inv. Map MF-171, scale 1:24,000, lat. 46°22'-46°30'N., long 112°-112°15'W., 1960, pub. 1961.

3-1038. Becraft, George E. PRELIMINARY GEOLOGIC MAP OF THE SOUTHERN HALF OF THE JEFFERSON CITY QUADRANGLE, JEFFERSON COUNTY, MONTANA: U.S. Geol. Survey, Mineral Inv. Map MF-172, scale 1:24,000, lat. 46°15'-46°22'N., long. 112°-112°15'W., 1960, pub. 1961.

3-1039. U.S. Geological Survey. SCOTTS BLUFF NATIONAL MONUMENT, NEBRASKA: scale 1:15,840, contour interval 10 ft., lat. 41°48'45"-41°52'N., long. 103°41'-103°44'W., 1939, reprinted 1960.

3-1040. Wong, H.D. GEOLOGY OF THE ALEXANDRIA QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 8 refs.

3-1041. Lee, K.Y. GEOLOGY OF THE FLANDREAU QUADRANGLE, SOUTH DAKOTA: South

Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 6 refs.

3-1042. Hoff, Jerald H. GEOLOGY OF THE GANN VALLEY QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 3 refs.

3-1043. Stevenson, Robert E. GEOLOGY OF THE LITTLE EAGLE QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 8 refs.

3-1044. Stevenson, Robert E. GEOLOGY OF THE MISCOL QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1959, 8 refs.

3-1045. Collins, Sam G. GEOLOGY OF THE PATRICIA QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 7 refs.

3-1046. Sevon, William D. GEOLOGY OF THE RING THUNDER QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 5 refs.

3-1047. Lee, K.Y. GEOLOGY OF THE RUTLAND QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 5 refs.

3-1048. Harksen, John C. GEOLOGY OF THE SHARPS CORNER QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 5 refs.

3-1049. Sevon, William D. GEOLOGY OF THE SPRING CREEK QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 4 refs.

3-1050. Stevenson, Robert E. GEOLOGY OF THE TIMBER LAKE QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 2 refs.

3-1051. Collins, Sam G. GEOLOGY OF THE WINNER QUADRANGLE, SOUTH DAKOTA: South Dakota, State Geol. Survey, Geol. Quad. Map Ser., col. map, scale 1:62,500, text on reverse of map sheet, 1960, 11 refs.

3-1052. Weir, Gordon W., and Willard P. Puffett. PRELIMINARY GEOLOGIC MAP AND SECTIONS OF THE MOUNT PEALE 2 NE QUADRANGLE, SAN JUAN COUNTY, UTAH: U.S. Geol. Survey, Mineral Inv. Map MF-141, scale 1:24,000, lat. 38°22'30"-38°30'N., long. 109°15'-109°22'30"W., 1960, pub. 1961.

3-1053. Weir, Gordon W., and Willard P. Puffett. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 4 SE QUADRANGLE, SAN JUAN COUNTY, UTAH, AND SAN MIGUEL COUNTY, COLORADO: U.S. Geol. Survey, Mineral Inv. Map MF-149, scale 1:24,000, lat. 38°-38°07'30"N., long. 109°-109°07'30"W., 1960, pub. 1961.

3-1054. Weir, Gordon W., and others. PRELIMINARY GEOLOGIC MAP AND SECTIONS OF THE MOUNT PEALE 4 NE QUADRANGLE, SAN JUAN COUNTY, UTAH, AND MONTROSE AND SAN MIGUEL COUNTIES, COLORADO: U.S. Geol. Survey, Mineral Inv. Map MF-150, scale 1:24,000, lat. 38°07'30"-38°15'N., long. 109°-109°07'30"W., 1960, pub. 1961.

3-1055. Brown, Robert D., Jr., and others. GEOLOGY OF THE PORT ANGELES-LAKE CRESCENT AREA, CLALLAM COUNTY, WASHINGTON: U.S. Geol. Survey, Oil & Gas Inv. Map, OM-203, scale 1:62,500, 1960, pub. 1961.

The map shows the distribution of a thick sequence of sedimentary and volcanic rocks of Tertiary age in about 300 sq. mi. in the N.-central part of the Olympic Peninsula. Three structural sections, an index map, and a composite stratified section of the rock units mapped is accompanied by a brief text describing the geology and oil and gas possibilities of the area.--U.S. Geol. Survey.

3-1056. EL PETROLEO DE LA REPUBLICA ARGENTINA [Petroleum in the Argentine Republic]: scale 1 in. to approx. 115 mi., Petroleo Interamericano, P.O. Box 1260, Tulsa 1, Oklahoma; pub. as supp. to Petroleo Interamericano, v. 18, no. 2.

Map shows oil fields; oil and gas pipelines in operation; proposed oil and gas pipelines; storage plants, division bulk stations, refineries; bids under consideration; area offered for checkerboard bidding; area where 3,000 wells are being drilled by Kerr-McGee, SAIPEM (ENI), Southeastern; area under contract to private companies.

3-1057. Wilkins, H.P. MOON MAPS, WITH A CHART SHOWING THE OTHER SIDE OF THE MOON, BASED UPON SOVIET PHOTOGRAPHS: 37 p., 27 maps, New York, Macmillan, 1960 [c1959].

The surface of the moon is marked by dark areas, or plains, once thought to be seas and called maria, with smaller dark areas, sinus or Bay, lacus or lake, and palus or marsh; a vast number of approximately circular features called craters, the largest termed walled-plains, the smallest, craterlets; mountain ranges, isolated peaks, chasms or clefts, and bright rays. The dark plains and 700 of the principal craters have been named while the smaller features are distinguished by a letter. It has been estimated that about 200,000 craters, of all sizes, can be detected with the largest telescopes.

The accompanying map of the moon depicts approximately 90,000 objects and is the most detailed in existence for students of selenography. The original map, 300 in. in diameter, was published in 1946 in 25 sections. These sections were revised

and brought up to date and published in The Moon by Wilkins and Moore, 1955. The present book meets a demand for the map in a form more convenient for use at the telescope. The gazeteer-text is an alphabetical list of all named objects, the map section in which they will be found, and concise notes of the principal features of interest. The 25 principal sections depict the lunar surface as seen under conditions of mean libration. A special section shows the great walled-in plain of Ptolemy in detail.

Of the entire lunar surface, 59% is visible, the remaining 41% being permanently concealed. On Oct. 6, 1959, the Soviet space rocket Lunik III secured photographs of a large portion of the normally invisible side. The chart of the averted hemisphere has been compiled from both sources, direct observation for features close to the limb and the Soviet photograph for the remainder. Only a comparatively narrow zone bordering the E. side of the disc remains unknown. The nomenclature of the averted hemisphere is that adopted by the Academy of Sciences, U.S.S.R.--From introd.

PART 2. AREAL AND REGIONAL GEOLOGY

3-1058. Aitken, James D. ATLIN MAP-AREA, BRITISH COLUMBIA: Canada, Geol. Survey, Mem. 307, 89 p., 6 illus., 4 maps (Map 1082A, col. geol. map, scale 1:253,440, in pocket), sec., diags., 3 tables, 1959, 29 refs.

The geological record in the map-area [59°-60°N. 132°-134°W.] begins with the schists and gneisses of the Yukon group, which record the accumulation of thick sedimentary rocks in pre-Permian times. The Sylvester group, metamorphosed sedimentary and volcanic rocks of Mississippian and/or older age found in the northeastern corner of the map-area, may be equivalent to a part of the Yukon group. The Yukon and Sylvester groups were folded and metamorphosed, and the Yukon group was intruded by quartz monzonite before the deposition of the rocks that appear next in the geological record.

The accumulation of the dominantly volcanic rocks around Llewellyn Inlet either preceded or was contemporaneous with the deposition of the very thick volcanic and marine sedimentary rocks of the Cache Creek group in Pennsylvanian and Permian times. The Atlin ultramafic intrusions are thought to have been emplaced during the volcanic epochs of the Pennsylvanian and Permian.

The next depositional event of which a record remains is the accumulation of a part or all of the rocks grouped as "undifferentiated, mainly volcanic rocks." This took place in the very late Permian or early Triassic after the Cache Creek group had been folded into a northwesterly trend characteristic of every age of folding in the region. Although direct evidence is lacking, it appears probable that the sedimentary and volcanic rocks of the Triassic(?) SW. of Horsefeed Creek, which may be equivalent to a part of the "undifferentiated" volcanic rocks, also were deposited unconformably on the folded Cache Creek rocks during the Triassic.

Deposition of the marine sedimentary rocks of the Laberge group during the Jurassic period apparently followed conformably upon that of the rocks of probable Triassic age.

A surface of mountainous relief had been etched onto the folded Laberge group; however, their emplacement is an event that might be expected to accompany or immediately follow the folding of the Laberge rocks. Tectonic quiet prevailed at the time of emplacement of the Surprise Lake batholith and the Dawson Peaks stock in late Lower or early Upper Cretaceous time. This quiet period post-dates the emplacement of the Coast intrusions and presumably postdates the folding of the Laberge group.

A surface of mountainous relief had been etched onto the folded Laberge rocks when the dominantly volcanic Sloko group began to accumulate in the late Cretaceous or early Tertiary. The principal N.-side-up displacement on the Nahlin fault was complete by this time also. Emplacement of plugs and stocks of granophyre, gabbro, and diorite either accompanied or followed the Sloko volcanism. The position of the quartz monzonite stocks at Teresa Island and Atlin Mountain with respect to these events is not known.

After the mild warping and small-scale faulting of the Sloko group, the geological record is one of erosion, except for the extrusion and subsequent tilting of some minor masses of basalt during the Tertiary and further extrusions of basalt in the Pleistocene after the topography had been sculptured to its modern aspect.

The area was glaciated at least twice, and probably more than twice, during the Pleistocene. These events profoundly affected the topography, and gave rise to widespread and locally thick superficial deposits.--Auth., p. 11-12.

3-1059. Stevenson, I.M. SHUBENACADIE AND KENNETCOOK MAP-AREAS, COLCHESTER, HANTS AND HALIFAX COUNTIES, NOVA SCOTIA: Canada, Geol. Survey, Mem. 302, 88 p., 6 illus., 2 col. geol. maps (Maps 1075A, 1076A, in pocket), scale 1:63,360, 5 plans (1 in pocket), 1959, 55 refs.

The map-areas [45°-45°15'N. 63°-64°W.] are underlain by rocks that range in age from probable Ordovician to Triassic. The oldest formations are those of the Meguma group, which, from recent fossil findings, has been ascribed to the Ordovician. The Meguma strata are unconformably overlain by sediments of the Horton group of early Mississippian age. The latter are in turn overlain, probably disconformably, by a sequence of marine sediments of the Windsor group of late Mississippian age. The youngest Paleozoic rocks are buff-weathering feldspathic sandstones that conformably overlie the Windsor strata in each map-area. They have been tentatively correlated with the Riversdale group of Pennsylvanian age by meager fossil evidence and lithological similarity. A narrow band of Triassic rocks outcrops along the S. shore of Minas Basin. Stratified layers of clay, sand, silt, and lignite of Cretaceous age occur in Shubenacadie map-area.

Relative to the Meguma group, Horton and Windsor rocks are but little disturbed. Some folding took place between the Mississippian and Pennsylvanian periods, as evidenced by the relatively undisturbed strata of Pennsylvanian and Triassic ages. All rocks have been extensively faulted, but surface expression of the faults is usually obscured by glacial debris.

The map-areas contain deposits of Au, Sb, Pb-Zn, barite, Mn, gypsum, limestone, building stones and slates, coal, and gravel. The petroleum possibilities of the Kennetcook map-area were recently investigated.--Auth.

3-1060. Béland, Jacques. PRELIMINARY REPORT ON RIMOUSKI-MATAPEDIA AREA, ELECTORAL DISTRICTS OF RIMOUSKI, MATAPEDIA, BONAVENTURE AND MATANE: Quebec, Dept. Mines, Prelim. Rept. no. 430, 18 p., fold. geol.

map (Prelim. Map no. 1342), scale 1:126,720, 1960, 12 refs.

The Rimouski-Matapedia area covers about 2,000 sq.mi. in the Appalachian uplands, W. of Gaspé Peninsula. It is bounded on the N. by the limit of outcrop of the Silurian and Devonian rocks, on the S. by the Quebec-New Brunswick boundary and, on the W. and E., respectively, by the Rimouski and Matapedia rivers.

The Appalachian mountains in this part of Quebec can be divided into 3 parallel, northeasterly-trending belts. In the northern and southern belts are older, tightly-folded rocks which form a floor for a basin of younger rocks occupying the medial belt. The younger rocks are gently folded in the northern part of the basin but markedly deformed in the southern part. N. of the basin of Silurian and Devonian rocks, the older rocks belong to the Quebec group and are Lower to Middle Ordovician; in the S. they belong to the Upper Ordovician Matapedia group. The Silurian-Devonian sequence is here divided into 8 formations. An angular unconformity separates these younger rocks from those of the Quebec group in the N. On the S., the relationships between Ordovician and younger rocks are obscured by a fault, but, S. of the area, Silurian strata rest unconformably on a lower facies of the Matapedia group.

A narrow band of rock assigned to the Quebec group crops out within the central basin of younger rocks in the northeastern corner of the area.

Intrusive rocks are few and most of them are dikes or sills.--Auth., p. 1-2.

3-1061. Berrangé, J.P. PRELIMINARY REPORT ON ANTOINE AREA, ELECTORAL DISTRICT OF ROBERVAL: Quebec, Dept. Mines, Prelim. Rept. no. 429, 12 p., fold. geol. map (Prelim. Map no. 1341), scale 1:63,360, 1960, ref.

Precambrian rocks underlie the entire area. The oldest rocks are the highly folded Grenville paragneisses with some associated orthogneisses.

Anorthositic rocks occur mainly near the NE. corner of the area. They are part of the marginal dioritic facies of the Lake St.-Jean anorthosite massif. The anorthositic rocks have been intruded by a heterogeneous group of rocks that includes a coarse porphyritic diorite, which is older than a suite comprising plagioclase porphyry, diorite, monzonite, and syenite as well as quartz diorite, quartz monzonite, and quartz syenite. Both the anorthositic and intermediate rocks contain pyroxene (commonly hypersthene) and are presumably derived from the same magma.

A suite of pink, leucocratic, biotite granites partly surrounds the composite pluton of intermediate rocks between the Grenville paragneisses and associated orthogneisses. These granites extend northward to form a large body of similar granite containing numerous large screens of paragneisses and orthogneisses.

Numerous acidic intrusive rocks, including pegmatites, aplites, quartz veins, and fine-grained granite dikes, occur here and there throughout the area but are especially common in the Grenville terrain.--Auth., p. 2.

3-1062. Blais, Roger A. WACOUNO-WACO AREA, SAGUENAY ELECTORAL DISTRICT: Quebec, Dept. Mines, Geol. Rept. 96, 58 p., 23 illus., 4 maps (2 col. geol. maps in pocket, scale 1:63,360), 1960, 17 refs.

All consolidated rocks in the area are Precambrian. They consist of paragneisses intruded by granitic gneisses and basic rocks, which, in turn, are cut by a younger granite and various minor dikes. Paragneisses and basic intrusive rocks, roughly in equal amounts, underlie about one-quarter of the area. The remainder is occupied by granitic rocks, either gneissic and conformable to the sedimentary rocks, or massive and generally intrusive into surrounding formations.

The paragneisses rocks are well layered and include a few lenticular beds of quartzite and of silicated crystalline limestone. They are widespread and form long and narrow belts within gneissic granite. The paragneiss belts, as mapped, include large amounts of mixed and banded gneisses (migmatites) made up of varying amounts of granitic material of intrusive origin.

The basic rocks, nearly all restricted to the Waco area, generally are in thick, tabular, intrusive bodies that are more or less conformable with the structure of surrounding orthogneisses and paragneisses. A large mass of anorthosite, with gabbroic, monzonitic and syenitic border facies, extends from just within the E. boundary of Waco area more than 20 mi. eastward.

Granitic rocks of variable composition predominate over all other rocks. They are either gneissic or massive. Most of the distinctly gneissic granites contain isolated remnants of sedimentary rocks and, together with these, form a complex into which gabbros and other granites have been intruded. Augen gneiss, gneissic granite, and granite gneiss are the main varieties of these early, intrusive or metasomatic granitic rocks. They outcrop in wide and long belts over more than half of the area. The late granites are generally massive and crop out as large bodies, the main one covering more than half of the Wacouno area, and as small stocks and bosses piercing through the complex of gneisses. The early granitic gneisses differ from the later massive granites in structure, texture, composition, and mode of occurrence.

Dikes of pegmatite, aplite, and lamprophyre, as well as veins of quartz, cut the late granites and are therefore presumed to be the youngest intrusive rocks in the area. Both pegmatite and aplite are closely associated with the late granites.--Auth., p. 12-13.

3-1063. Smith, J.R., and G. Allard. SOUTH HALF OF McKENZIE TOWNSHIP, ABITIBI-EAST ELECTORAL DISTRICT. PART I. SOUTHWEST QUARTER AND NORTH HALF OF SOUTHEAST QUARTER. PART II. SOUTH HALF OF SOUTHEAST QUARTER: Quebec, Dept. Mines, Geol. Rept. 95, 71 p., 2 col. geol. maps (in pocket), scale 1:12,000, 1960, 11 refs.

Pt. 1. The oldest rocks exposed are Keewatin-type volcanics in which there is a distinct, but somewhat irregular, change from basic lavas (metabasalts) in the S. through intermediate types (metaandesites?) in the central part to feldspathic lavas and clastic rocks in the N. Sills of metagabbro intrude the lavas and the clastic rocks. In the northern part of the area the clastic rocks are extensively intruded by ultrabasic rocks of various kinds; quartz-feldspar porphyry dikes and a body of soda granite intrude clastic rocks and ultrabasic rocks. In the southern part of the area basic dikes intrude the lavas and quartz-feldspar porphyry. Erosional remnants of relatively undisturbed bedded, unmetamorphosed arkoses, conglomerates, and graywackes of

the Chibougamau series (Proterozoic?) rest unconformably on the older rocks. All of these rocks are in places strongly metasomatized.

Layers in the lavas and beds in the clastic rocks dip vertically to steeply N. and in general strike ENE. The igneous intrusions, especially the metagabbro bodies, are elongate parallel to the strike of the layered volcanic rocks, suggesting that they are sill-like in form. Top determinations show that the tops of flows and beds in the volcanic rocks and the tops of the metagabbro sills face N. from the southern limit of the area to the S. contact of the main ultrabasic intrusions. Therefore, the layered rocks of the area appear to form part of a thick, nearly vertical S. limb of a major syncline.

Faults, for the most part with very minor displacements, are grouped on the basis of their general strike into an ENE. set, a WNW. to NW. set, and a NE. to N. set.

Quartz veins, for the most part barren, but in a few places carrying coarsely crystalline carbonate, minor pyrite and chalcopyrite, and rare sphalerite, are abundant in the area. A few of the veins carry traces of Au, and at least one contains notable amounts. Veins carrying the greatest amounts of metallic minerals are in rusty-weathering carbonatized shears associated with both ENE. and NW. faults. At Berrigan Lake, sulfides are most abundant in those parts of a zone of carbonatized rock which have been silicified and veined by quartz and brecciated.

Pyrite and magnetite disseminated in metasomatic rocks SE. of Sauvage Lake have not been found in important concentrations; the relative abundance of metallic minerals in the metasomatic rocks is, however, noteworthy. The mineralizing solutions were apparently localized along the same channels as the metasomatizing solutions, or were perhaps directly related to the same source.

Disseminated magnetite in the ultrabasic rocks, being a by-product of the serpentinization of those rocks, probably does not occur in workable concentrations. Although no chromite has been found in the ultrabasic rocks, the possibility of its occurrence should not be overlooked. Brittle-fibre asbestos occurs in unimportant quantities in the ultrabasic rocks. One small occurrence of graphite schist associated with ultrabasic rock was found S. of Antoinette Lake.--Auth. p. 5, 31.

Pt. 2. The area can be divided into 2 parts: a smaller area to the N. underlain by volcanic rocks, and a greater area to the S. underlain by the plutonic rocks of the Doré Lake complex. All of the consolidated rocks are Precambrian. The volcanic group, presumably the oldest group of the area, is here called the Keewatin-type series; the term implies a predominantly volcanic assemblage lithologically similar to the original Keewatin-type section. The southern part of the map-area is underlain by rocks of the Doré Lake complex: metaanorthosite, metagabbro, a transition member between metaanorthosite and metagabbro, metapyroxenite, and granophyre. All of the rocks except a few members of the Doré Lake complex have been metamorphosed to the greenschist facies. Practically no original minerals remain intact except the magnetite and ilmenite in some layers of the Doré Lake complex.

The area is transected by 2 main sets of fractures, a major northeasterly-trending set, parallel to the Grenville front, and a northeasterly-trending set which is of economic importance. The latter consists of short shear zones of variable width along which veins containing chalcopyrite, sphalerite, and siderite have been localized. Hydrothermal alteration and intense shearing are characteristic of these zones; carbonatization and development of chloritoid are the main types of hydrothermal alteration, but silicification, chloritization, and sericitization are also common.

Many sulfide zones have been discovered in this area. The main sulfide mineral is chalcopyrite; pyrite, pyrrhotite, and sphalerite are present in variable amounts, generally less than the chalcopyrite. All of the mineralized zones found to date are located along dikes in northwesterly-trending shear zones having dips steeper than 45°. The dikes are generally highly altered and are either sheared or massive. The sulfides replace a sericite-chlorite schist. The localization of the sulfide bodies is thought to be related to dilational openings formed between the brittle dikes and incompetent schist during movement along the northwesterly-trending shear zones. The relation of the sulfide zones to the NE. and NNE. shears is not clear, but these zones bear a close spatial relationship to the Doré Lake and Sauvage Lake faults.--Auth. p. 44, 59.

3-1064. Four Corners Geological Society. GEOLOGY OF THE PARADOX FOLD AND FAULT BELT. THIRD FIELD CONFERENCE, 1960: 173 p., illus., maps, charts, secs., diag., 1960, refs.

Geologically, the Uncompahgre-Salt Anticline country is very complex. Important economic status was attained a few years after World War II when major U ore reserves were discovered in sandstone bodies on the Colorado Plateau. The Salt Anticline country has also recently been raised to the rank of major petroleum production. The guidebook and field trip provide an opportunity for observation and discussion of some of the problems of the area. Papers are listed below in the order in which they appear in the guidebook.

GENERAL PAPERS

History of the Four Corners Geological Society, by Sherman A. Wengerd and Kenneth G. Smith, p. 11-14.

The National Forests, by Roan C. Anderson, p. 15-16.

Arches National Monument, by Lloyd Pierson, p. 17-21.

Land and Leasing in the Salt Anticline Area of the Paradox Basin, by Clinton C. Putnam, p. 23-25.

Stratigraphic Nomenclature of the Northern Paradox Basin, by Nomenclature Committee, Four Corners Geological Society, p. 26-30.

Physiography and Geomorphic History of Part of Southeastern Utah and Adjacent Colorado, by Walter R. Buss, p. 31-32.

Disposal of Radioactive Wastes in Natural Salt, by F.L. Parker and others, p. 33-42.

STRUCTURAL PAPERS

Geology of Sinbad Valley Anticline, by Raymond E. Maret and A.V. Robertson Coe, p. 43-46.

Late Paleozoic and Early Mesozoic Structural History of the Uncompahgre Front, by Donald P. Elston and Eugene M. Shoemaker, p. 47-55.

Comparisons Between the Salt Anticlines of South Persia and Those of the Paradox Basin, by Arthur W. Neff, p. 56-67.

STRATIGRAPHIC PAPERS

Cambrian, Devonian and Mississippian Rocks of the Four Corners Area, by Jack Cooper, p. 69-78.

Pennsylvanian of the Paradox Basin Salt Structure Area, by Harold H. Brown, p. 79.

Late Paleozoic Paleontology in the Northern Paradox Basin, by John Chronic, p. 80-85.

Stratigraphy of the Saline Facies of the Paradox Member of the Hermosa Formation of Southeastern Utah and Southwestern Colorado, by Robert J. Hite, p. 86-90.

Permian Stratigraphy in the Salt Anticline Region of Western Colorado and Eastern Utah, by Robert P. Kunkel, p. 91-97.

Triassic Strata of the Salt Anticline Region, Utah and Colorado, by John H. Stewart and Richard F. Wilson, p. 98-106.

Wingate through Summerville Formations in the Area of Salt Anticlines, Utah-Colorado, by Raymond C. Robeck, p. 107-108.

ECONOMIC PAPERS

From X-Rays to Fission, A Metamorphosis in Mining, by Clay T. Smith, p. 109-114.

Exploration and Development Drilling in the Uravan Mineral Belt, by James S. Hastings, p. 115-117.

Manganese Deposits of the Little Grand District in Southeastern Utah, by Frank O. Bowman, Jr., p. 118-120.

Notes on the Pure Oil Company Discovery at Northwest Lisbon, by Harrell Budd, p. 121-124.

Oil and Gas Prospects in the Paradox Basin, by James L. Tatum, p. 125-126.

Big Flat Field, Utah, by J. W. Parker, p. 127-132.

Drilling Mud Procedures in the Lisbon Valley Area of the Paradox Basin Fold and Fault Belt, by Gene Polk, p. 133-137.

Carbon Dioxide, Nitrogen, and Helium in Mississippian of Four Corners Region, Preliminary Statement, by M. Dane Picard, p. 138-140.

Devonian Lithology, Identification Utilizing Porosity Logs, by George F. Chamblis, p. 141-146.

ROAD LOGS

First Day - October 5, 1960, Moab, Utah, to Monogram Mesa, p. 147-158.

Second Day - October 6, 1960, Monogram Mesa to Roc Creek, Colorado, p. 159-166.

Third Day - October 7, 1960, Roc Creek, Colorado, to Moab, Utah, p. 167-173.

3-1065. Pitt, William D., and others. OUACHITA MOUNTAIN CORE AREA, MONTGOMERY COUNTY, ARKANSAS: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 1, p. 72-94, 12 illus., 6 maps, 10 secs., Jan. 1961, 18 refs.

The purpose of this study was to investigate in detail the core area of the Ouachita Mountains of southwestern Arkansas. As work progressed it was discovered that High Peak and Wheeler Mountain ridges are not homoclinal, as originally mapped by Miser and Purdue, but rather are anticlinal. According to our interpretation there are only 2 outcrop areas of Collier shale in the Crystal Mountains: those along upper Collier Creek and upper Huddleston Creek. This fact is stratigraphically significant in that almost no dark bluish gray limestone was found by the writers in these remaining 2 outcrop areas of Collier shale. Another significant change in the stratigraphy is that of the thickness and lithologic character of the Crystal Mountain sandstone, which Miser and Purdue described as "almost entirely" sandstone and as being 850 ft. thick. Pitt discovered that the measurable interval of the Crystal Mountain sandstone in the Crystal Mountains is only 180-320+ ft. Lithologically the measured interval consists of 2 massive sandstone beds, 30-80 ft. in thickness, separated by about 100 ft. of thin beds of siltstone and shale. Locally as much as 50 ft. or possibly slightly more of interbedded sandstone and shale makes up the uppermost member in the Crystal Mountains. In the Mount Ida area N. of the Crystal Mountains the Crystal Mountain sandstone ranges in thickness from 280 to 370 ft. because the uppermost member is thicker than it is in the Crystal Mountains. No conglomerate or other suggestion of an unconformity was found at the base of the Crystal Mountain sandstone; the writers therefore believe that the Collier shale is probably Ordovician in age rather than Cambrian.

The outcrop of supposed Collier shale N. of Wheeler Mountain and near the town of Mount Ida is actually Mazarn shale. This Mount Ida area is one of sharp anticlinal folds with gentle westward plunge. Most of the Crystal Mountain sandstone ridges have been overturned southward. Faulting is rare throughout the Mount Ida area. The few observed faults are tear faults, but their presence suggests that minor thrust faults also may be present.--Auth.

3-1066. Society of Economic Paleontologists and Mineralogists, Pacific Section. GUIDEBOOK, 1960 SPRING FIELD TRIP, APRIL 15-16, 1960. TYPE PANOCHE, PANOCHE HILLS AREA, FRESNO COUNTY, CALIFORNIA, by Max B. Payne: 15 p., 3-p. supp., 6 figs. incl. 3 maps, 1960.

The guidebook and the field trip were designed to show the type section of the Panoche group [Upper Cretaceous], originally described as a formation by Anderson and Pack in 1915. Recent mapping on an aerial photograph base provided details necessary to divide the 22,020 ft. of the Panoche into several formations and members, which are both lithogenetic and cartographic units. Recent work by Tatsuro Matsumoto on the ranges of ammonites and inocerami, and by Lewis Martin on the Foraminifera, shows that the Panoche group ranges in age from the Cenomanian to Maestrichtian.

Franciscan rocks crop out in a small area to the W. as shown on the Panoche Hills geologic sketch map in the guidebook. Serpentine and several kinds of ultrabasic masses account for many structural complexities. The eastern part of the Panoche Hills is a gently bowed homocline. In the southwestern part of the area the strata are folded into a south-easterly-trending nose. Minor faulting occurs at the N. and S. ends of the hills, and on the W. the Panoche group is faulted against the Franciscan.

The Moreno formation overlying the Panoche group is Maestrichtian in age, except for the upper part, Dos Palos shale, which is Danian. Deposition through this part of the section was apparently continuous. The source of the material for the type Panoche group sediments appears to have been from the Sierra Nevada Mountains, but there is evidence that some western source also contributed.--Auth.

3-1067. Bush, Alfred L., and others. AREAL GEOLOGY OF THE LITTLE CONE QUADRANGLE, COLORADO: U.S. Geol. Survey, Bull. 1082-G, p. 423-492, 6 maps incl. col. geol. map (in pocket), scale 1:24,000, sec. (in pocket), 1960, 39 refs.

Generally flat-lying, but broadly folded sedimentary rocks are cut by sills, dikes, a plug, and a laccolith, and displaced along numerous, steeply dipping normal faults. The sedimentary rocks include the Late Triassic Dolores formation, the Late Jurassic Entrada sandstone and Wanakah and Morrison formations, Early Cretaceous Burro Canyon formation, and Late Cretaceous Dakota sandstone, and Mancos

shale. Broad folds, part of a system of regional extent, date from the end of the Cretaceous or early in the Tertiary.

Granogabbro, intrusive into the Dakota and Mancos, forms the Flat Top Peak plug, the Little Cone laccolith, several sills and dikes. Less abundant granodiorite forms sills in the Dakota and Mancos as well. Rhyolite makes a single thin, widespread sill in the Dakota; microgabbro forms a dike cutting all the sedimentary rocks. These igneous rocks probably are Miocene in age.

Normal faults, probably somewhat younger than the igneous rocks, form 2 long, narrow, northward- and northwestward-trending grabens, extensions of 2 fault systems in the quadrangles to the N. and NW. Other faults trend eastward to northeastward; some of these appear to be related to the emplacement of the igneous rocks.

In the quadrangle, and to the N. and E., the Entrada sandstone contains V deposits (roscoelite) with associated low-grade U. The deposits form a practically continuous layer about 10 mi. long (3 1/2 mi. within the quadrangle) and 1-1 1/2 mi. wide; they range from a knife edge to more than 20 ft. in thickness.--A. L. Bush.

3-1068. Gulf Coast Association of Geological Societies. GUIDE BOOK, CENOZOIC FIELD TRIPS, OCTOBER 19-21, 1960. RECENT SEDIMENTATION ON HORN ISLAND, MISSISSIPPI, by Richard R. Priddy and Baxter L. Smith. STRATIGRAPHY OF THE QUATERNARY AND UPPER TERTIARY OF THE PASCAGOULA VALLEY, MISSISSIPPI, by E. J. Harvey and J. L. Nichols: 23 p., illus., maps, chart, secs., 1960, 40 refs.

The primary objective of the field trips was to demonstrate the nature and variety of the surface geology present along the Mississippi Gulf Coast. Two areas in the Biloxi vicinity, Horn Island in the Mississippi Sound and the Pascagoula River valley, were selected as representative examples. These areas are currently under geologic investigation by both governmental and private organizations dealing with exploration and research in the fields of groundwater resources, oil and gas exploration, marine wildlife studies, and shoreline erosion and sedimentation problems. The material presented in this guidebook is basically descriptive rather than interpretive. The locations and character of outcrops and surface materials and many natural processes and environments are identified and observed.

The offshore trip to Horn Island, which lies approximately 8 to 10 mi. off the Mississippi coast and 12 mi. SE. of Biloxi, affords observation of many active sedimentation and erosion processes as well as an environmental look at the geologically important back-bar region, the Mississippi Sound. The barrier island, recently altered in physical form by the hurricanes of early fall, presents nearly limitless material for study. Each hour, as well as each season, the older sedimentary structures change while new features are forming. The many physical and ecological characteristics of the sound, its waters, bottoms, and life forms, and their distribution, are all subjects of modern study.

The onshore trip through the Pascagoula River valley commences about 15 mi. E. of Biloxi and extends some 40 mi. northward. While the surface stratigraphy of the Upper Tertiary and Quaternary is studied, particular emphasis is placed on the character, history, and nomenclature of the Pleistocene and Recent terraces of the coastal area. Relationships of topography and terrace development are observed, and terrace correlations and names are presented.--From foreword.

3-1069. Bryant, Bruce H., and others. GEOLOGY OF THE MADDUX QUADRANGLE, BEARPAW MOUNTAINS, BLAINE COUNTY, MONTANA: U.S. Geol. Survey, Bull. 1081-C, p. 91-116, 2 maps (col. geol. map in pocket, scale 1:31,680), 1960, 33 refs.

The Maddux quadrangle which has an area of about 200 sq. mi., is in the southeastern part of the Bearpaw Mountains. About 20% of the quadrangle is underlain by sedimentary rocks of Late Jurassic to Recent age and 80% by intrusive and extrusive igneous rocks of middle Eocene age.

The consolidated sedimentary rocks are subdivided into 18 formations, which have a total stratigraphic thickness of about 7,900 ft. The surficial deposits include pediment and terrace gravels of Pliocene(?) and Pleistocene age and alluvium of Recent age. The maximum stratigraphic thickness of these deposits is about 100 ft.

The intrusive igneous rocks of the Maddux quadrangle occur as simple and composite stocks, dikes, plugs, and sills. The extrusive rocks form an interlayered pile of mafic and felsic lava flows, pyroclastic deposits, and volcanic sediments. The mapped flow units also include some irregular pluglike bodies of intrusive rock that are indistinguishable from and merge with the flows. The maximum stratigraphic thickness of the sequence of layered volcanic rocks is about 30,000 ft.

The igneous rocks range in composition from subsilicic-alkalic to silicic-alkalic and include representatives of the shonkinitic, syenitic, and quartz monzonitic families. Within the quadrangle, mafic-lava flows exceed felsic-lava flows in area distribution by a ratio of about 2 to 1. However, intrusive porphyritic latite is about as abundant as intrusive shonkinitic rock.

The principal structural feature of the Bearpaw Mountains uplift is the Bearpaw Mountains structural arch, an eastward-trending belt of uplifted and deformed sedimentary rocks that has been extensively intruded by many types of igneous rocks. Part of the southern limb of this arch lies in the northern part of the quadrangle, and the arch is bordered on the S. by the eastern portion of the southern volcanic field - a wide expanse of volcanic rocks that forms the S. flank of the Bearpaw Mountains. In general, the layered units in this part of the southern volcanic field have a northeastward strike and dip NW. toward the Bearpaw Mountains structural arch at angles of 10^{o}-65^{o}. Considered as a single mass, the southern volcanic field is a monoclinal structure dipping about 30^{o}NW. toward the arch.

Deformation and volcanism occurred in this region in the Eocene epoch. Faulted rocks in and adjacent to the volcanic field demonstrate deformation before, during, and after volcanism. In this quadrangle it cannot be determined whether disruption of the initial layering of the volcanic rocks is more likely the result of successive collapse or of plainsward landsliding as suggested by Reeves.

Mineral resources include minor amounts of bentonite, lignite and low-rank coal, and sparse deposits of galena, pyrite, and chalcopyrite. Vesicular mafic phonolite flows provide a source for road-surfacing material, and many masses of intrusive rock are a potential source of riprap.--Auth.

3-1070. Carolina Geological Society. FIELD TRIP GUIDEBOOK, ANNUAL MEETING, OCTOBER 8-9,

1960. ROAD LOG OF THE GRANDFATHER MOUNTAIN AREA, NORTH CAROLINA, by Bruce H. Bryant and John C. Reed, Jr.: 21 p., 2 maps, 1960, 16 refs.

In northwestern North Carolina, the Blue Ridge is composed largely of schists, gneisses, and granitic rocks of early Precambrian age which were involved in large-scale thrusting and subjected to one or more episodes of thermal and dynamic metamorphism during Paleozoic time. These rocks have been thrust northwestward over upper Precambrian and Cambrian rocks of the Unaka belt. The upper Precambrian and Lower Cambrian rocks in the Grandfather Mountain window show that the allochthonous rocks travelled relatively at least 30 mi. northwestward during the Paleozoic thrusting. In the inner Piedmont SE. of the Grandfather Mountain window, the predominant rocks are gneisses, schists, and granitic rocks of Precambrian and/or Paleozoic age. These rocks were thrust over those of the Grandfather Mountain window. The structural relations of the Piedmont rocks to the allochthonous rocks of the Blue Ridge are unknown, but reconnaissance mapping to the SW. of the window, especially in the Pisgah quadrangle, suggests that they may also be in fault contact with the Blue Ridge rocks.--Auth., p. 2.

During the field trip, some of the more important rock types and structural features were examined.

3-1071. West, Alvin E. GEOLOGY OF NORTHEASTERN LINCOLN COUNTY, OKLAHOMA: Shale Shaker, v. 11, no. 3, p. 2-13, 5 illus., 2 maps, secs., Nov. 1960, 34 refs.

Northeastern Lincoln County has been mapped in detail on the basis of marker beds traced from the platform area to the N. Units of Virgilian [Upper Pennsylvanian] and Lyonian [Lower Permian?] ages are identified and described in this area transitional into deltaic basinal red beds.--Auth.

3-1072. Noyes, Alvin Peter, Jr., and Keith Young. GEOLOGY OF PURGATORY CREEK AREA, HAYS AND COMAL COUNTIES, TEXAS: Texas Jour. Sci., v. 12, no. 1/2, p. 64-104, 10 figs. incl. illus., maps, secs., May 1960, 34 refs.

Comanche rocks [Cretaceous] dominate the outcrop in the Purgatory Creek area, with only scattered structural outliers of Gulf rocks. Outcropping formations of the Comanche series in ascending order are the Glen Rose, Walnut, Edward, Georgetown, Del Rio, and Buda formations. The overlying Eagle Ford and Austin formations represent the Gulf series [Cretaceous].

The Purgatory Creek area occupies an incompletely developed karst terrane with sinks, dolines, collapse structures, and extensive underground caverns, particularly in the Edwards limestone. Past solution during more humid environments has been aided by the joint systems, and is concentrated along faults in the Edwards limestone or on the Edwards limestone side of major gravity faults.--Auth.

3-1073. South Texas Geological Society. GUIDE BOOK, FALL FIELD TRIP. GEOLOGICAL SECTION, TAYLOR TO GLENROSE. DECEMBER 2-3, 1960: 29 p., maps (incl. highway map in pocket), secs., San Antonio, 1960.

Purpose of the field trip was to show the broader lithologic features of a part of the Cretaceous and to stimulate discussion on the correlation and facies changes. The carbonates, of most economic interest in the subsurface, received the most attention. The outcropping sediments in the vicinity of San Antonio and the San Marcos platform were contrasted with those outcropping along the northern edge of the Rio Grande embayment. Facies changes in the limestones were shown.--From foreword.

The route was: San Antonio - Culebra anticline - Castroville - Tarpley - Utopia - Leakey - Camp Wood - Chalk Bluff - Del Rio - Anacacho Mountains - Asphalt Quarries - D'Hanis.

3-1074. Brent, William B. GEOLOGY AND MINERAL RESOURCES OF ROCKINGHAM COUNTY: Virginia, Div. Mineral Resources, Bull. 76, 174 p., 3 figs. incl. map, 18 secs., 35 pls. incl. illus., 3 maps (in pocket), incl. geol. map, scale 1:62,500, 10 tables, 1960, 103 refs.

Rockingham County is in the northwestern part of Virginia and extends from the top of the Blue Ridge on the SE. to West Virginia on the NW. Its boundaries enclose an area of 871 sq. mi., mostly within the Appalachian Valley and Ridge province.

Bedrock of the county ranges in age from Precambrian to Mississippian but consists principally of Cambrian, Ordovician, and Devonian rocks. The rocks of sedimentary origin have a maximum thickness of 25,000 ft. The Precambrian rocks are in the Blue Ridge to the SE., and the Mississippian rocks occur in the western part of the county.

Precambrian rocks of the Blue Ridge consist of a complex of igneous and metamorphic rocks which is overlain unconformably by the thin Swift Run formation and by Catoctin greenstone. On the NW. side of the Blue Ridge are Lower Cambrian sandstones, shales, and quartzites succeeded by dolomites, limestones, and some interbedded shales. The central part of the county, the Shenandoah Valley, contains principally Cambrian and Ordovician limestones, dolomites, shales, and thin sandstones. Silurian and Devonian rocks occur in this area within the Massanutten Ranges. The western part of the county consists mainly of Devonian and Mississippian sandstones and shales, but Silurian and Ordovician rocks have small areas of exposure. A few basic intrusives in the form of dikes and sills and one plug, probably of Triassic age, cut the Cambrian and Ordovician sedimentary rocks.

Rockingham County is in the Appalachian Mountains, and its structural features, mostly of late Paleozoic age, are characteristic of that mountainous region. There are many relatively small folds in the Blue Ridge, but the rocks dip generally to the NW. Many faults occur but no large overthrusts are present in this area. In the central part of the county are NE.-SW. trending Cambrian and Ordovician rocks that have been complexly folded and faulted. A major structure is the Massanutten synclinal complex that extends completely across the county. The southwestern end of topographic prominence of the Massanutten Ranges is near Penn Laird and Montevideo. The Pulaski-Staunton thrust fault reaches almost across the county; the northeastern terminus is about 3 mi. S. of the Shenandoah County boundary. Roughly parallel to and about 10 or 12 mi. NW. of the Pulaski-Staunton fault is a major thrust fault, the Little North Mountain fault, which completely traverses Rockingham County. NW. of the Little North Mountain fault is Little North Mountain, which consists principally of steeply dipping to overturned Ordovician, Silurian, and Devonian rocks. NW. of

Little North Mountain there is some close folding but much of the area consists of broad gentle flexures. Faulting is confined mainly to small reverse and normal faults, too small to be shown on the geologic map of the county.

Rockingham County contains deposits of Fe, Mn, and Zn ores, limestone, building stone, and natural gas. Oxides of Fe and Mn occur in irregularly shaped bodies in the residuum of Lower Cambrian formations at the NW. foot of the Blue Ridge. These deposits are thought to represent concentrations from original carbonate minerals disseminated in the bedrock. There are many Zn showings in Ordovician carbonate rocks, and one active Zn mine in a breccia in Beekmantown dolomite near Timberville. High-Ca limestone and limestones suitable for dimension stone occur extensively in the county. Most of the active quarries produce limestone or dolomite for concrete aggregate, roadstone, or agricultural stone. Several natural gas wells have been drilled in the northwestern part of the county, near Bergton, but there is no gas production at present. Abundant water supplies seem to occur in the vicinity of the South Fork of Shenandoah River.--Auth.

3-1075. Harrington, Horacio J. GEOLOGY OF PARTS OF ANTOFAGASTA AND ATACAMA PROVINCES, NORTHERN CHILE: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 169-197, 3 maps, 3 secs., Feb. 1961, 22 refs.

A summary account of the geology of parts of the Atacama desert, northern Chile, between 22° and 26°S. Precambrian, upper Paleozoic, Mesozoic, and upper Tertiary rocks are displayed in the region. Precambrian metamorphics crop out in isolated exposures at the southern foot of the Limón Verde range. Upper Paleozoic sedimentites from the eastern half of the ranges between Toco and Tocopilla. Volcanic rocks, belonging to 3 different cycles of upper Triassic-lower Liassic, Malm-Neocomian, and Senonian age, respectively, are very extensively developed. These sequences contain intercalations of marine and continental sedimentites, exposed in isolated areas, and are intruded by Senonian granodiorites. The Jurassic and Cretaceous sedimentary sequences exposed at Moctezuma, Caracoles, Potrerillos-Pedernales, Purilactis, Sierra de Almeidia, and El Way are described in some detail. The eastern part of the region is formed of upper Tertiary continental beds and volcanic rocks. The Miocene-Pliocene sequence of the San Pedro de Atacama area is briefly described.--Auth.

3-1076. Paffengolts, K.N. ELBRUS (GEOLOGICAL SKETCH): Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 1-19, 2 illus., map, 3 secs., tables, pub. 1960, 37 refs.

This paper gives a detailed petrographic, mineralogic, and chemical description of various extrusive rocks of the Elbrus massif [Caucasus], divided here into 2 sequences. The lower one (up to 2 km. thick) has been definitely disturbed and dips generally NE. at 7° to 10°, with the upper one resting upon it, and making up the upper half of Elbrus; a lava flow is present on its northeastern slope in the Malka valley. Proof is cited for an Oligocene age of the lower sequence and for an Akchagyl age of the upper. A brief outline of the geologic history of the area is given.--Auth.

3-1077. Gorshkov, P.M. GEOLOGY AND TECTONICS OF THE KUZBAS: Internat. Geology Rev., v. 3, no. 1, p. 69-70, Jan. 1961, ref.

A brief summary of the geological history and structural elements of the Kuznetsk coal basin is given. The coal beds overlie Tournaisian limestones and were deposited in a gradually subsiding graben, which existed until the end of the Paleozoic. Continental deposition commenced in the Mesozoic and has continued to the present. Coal reserves in the Kuznetsk basin have been estimated at 400 billion tons.--M. Russell.

3-1078. Durkee, Edward F., and Selmer L. Pederson. GEOLOGY OF NORTHERN LUZON, PHILIPPINES: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 137-168, 4 illus., 4 maps, chart, 2 tables, Feb. 1961, 16 refs.

N. of 16°N. the island of Luzon, Philippines, consists morphologically, from E. to W., of: 1) the Sierra Madre, 2) an intermontane structural basin, the Cagayan Valley, 3) the Cordillera Central, and 4) a fragmentary exposure of a structural basin extending northward from the Central Valley basin of central Luzon, the W. margin of this basin lying beneath the South China Sea.

Luzon developed between the sialic continental region of China and the basaltic Pacific Ocean basin. This position has given it an intermediate to basic framework that supplied a predominance of quartz-deficient clastics to idiogeosynclines formed with it. The basement foundation of Luzon is predominantly of early Tertiary age. Most of the sediments accumulated in Miocene and Pliocene time. In early Miocene time the Cagayan and Central valleys were one interconnected depositional site. After deposition of the Sicalao and Kennon limestones (in the Cagayan and Central valleys respectively), the Cordillera Central became a positive zone separating 2 depositional basins. The Cordillera Central was the dominantly active tectonic feature of northern Luzon, while the Sierra Madre was a more stable or passive element.

The depositional environments in northern Luzon progressed from marine (Miocene) through marine-brackish (upper Miocene-Pliocene) to fluviatile (upper Pliocene-Pleistocene). Concurrent with this development of idiogeosynclines, filling of the basins, and over-all acceleration of uplift from Miocene to Pleistocene time, a volcanic cycle progressed from mafic to silicic (quartz-bearing tuffs in the Ilagan and Awidon Mesa formations of the Cagayan Valley) and a recent reversion to mafic extrusives (Mt. Cagua and Camiguin Island basalt cones).

Most of the anticlinal and synclinal trends visible at the surface, fault zones, and stratigraphic units have been named. Type sections are designated and described for the stratigraphic units discussed and mapped.--Auth.

3-1079. Doumani, George A. GEOLOGICAL OBSERVATIONS IN WEST ANTARCTICA DURING RECENT OVERSNOW TRAVERSES: Natl. Acad. Sci., IGY Bull. no. 41, p. 6-10, map, table, Nov. 1960.

Geological observations made thus far in W. Antarctica indicate that the mountains visited (with the exception of the Clark Mountains) form an archipelago of isolated, volcanic "islands," trending generally E.-W. and possessing geologic and physiographic similarities. Further study of the rocks in this portion of Antarctica will help to determine its relationship to the remainder of Antarctica and to neighboring continents. Continued investigation is neces-

sitated, moreover, by the failure thus far to observe major, broad-scale structural features in W. Antarctica that can be correlated with features of neighboring and surrounding parts of the globe.--Auth. summ.

3-1080. Voronov, P.S. LATE PRECAMBRIAN DEPOSITS OF THE AMUNDSEN AND SANDAU MOUNTAINS ON QUEEN MARY LAND, EASTERN ANTARCTIC: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 1-12, 7 figs. incl. illus., map, table, pub. 1960, 2 refs.

A description of the morphology, stratigraphy, and petrology of Amundsen and Sandau mountains in eastern Antarctica from findings of the 1956-1957 Soviet Antarctic Expedition. A group of late Precambrian green schists were discovered in an area where only crystalline schists and gneisses had been known. The 2 mountains, typical nunataks, belong to the same stratigraphic sequence, with higher beds exposed on the higher Amundsen Mountain. The metamorphics of the sequence are divided into 5 main groups: 1) metamorphic basalt rocks altered to epidote-chlorite schists with quartz-epidote and chlorite veins; 2) metamorphic quartz conglomerates; 3) assorted metamorphic quartz-feldspar and quartz sandstones, locally changed to quartzites; 4) metamorphic siltstones and argillites; 5) sericite schists. The Sandau green schists are probably Proterozoic; the overlying terrigeneous sequence may be Sinian. Multiple erosion and redeposition of the terrigeneous beds occurred.--A. Eustus.

2. GEOMORPHOLOGY

See also: Geologic Maps 3-1035, 3-1036; Sedimentary Petrology 3-1320.

3-1081. Butzer, Karl W. ARCHEOLOGY AND GEOLOGY IN ANCIENT EGYPT: Science, v. 132, no. 3440, p. 1617-1624, 6 maps, sec., Dec. 2, 1960, 42 refs.

Geologic, geomorphologic, and archeological investigations are combined to produce a clearer picture of population density and distribution in predynastic Egypt. Archeological sites favored for preservation lie on a narrow belt of unconsolidated or semi-consolidated material just above the present alluvial terrace level. The alluvium is gradually aggrading, and this tends to conceal sites located on the alluvium. On the favored belt, wind deflation and drifting dunes undoubtedly contribute to the erosion or burial of other sites. Thus the few rather scattered predynastic sites found thus far can be reconciled with a fairly dense and evenly distributed population.--F.P. Glasser.

3-1082. Beetham, Nellie, and William A. Niering. A POLLEN DIAGRAM FROM SOUTHEASTERN CONNECTICUT: Am. Jour. Sci., v. 259, no. 1, p. 69-75, diag., table, Jan. 1961, 16 refs.

A pollen diagram has been constructed from cores taken from the Red Maple swamp in the Connecticut Arboretum Natural Area at Connecticut College, New London. The pollen diagram shows a zone of much spruce-pine pollen and high N A P at the lower level followed by a zone dominated by spruce with 2 spruce maxima. This is followed by a zone dominated by pine and then by a zone dominated by deciduous tree pollen. The lowest zone, T-2, suggests a spruce-pine park-tundra type vegetation followed by the T-3 zone, where N A P is most abundant, indicating a dominance of herbaceous and shrubby forms. This latter zone (T-3) represents a most severe climatic interval which is presumed to correlate with the temporary halt of the ice 3 mi. N. of the Red Maple swamp (Ledyard moraine). Within the spruce period, 2 spruce maxima are separated by a minimum which represents a time of climatic amelioration correlated with the Two Creeks Interval. The second spruce maximum is correlated with the Valders advance. Well-differentiated stages within the C-zone, typical of most inland diagrams, are lacking. This is probably due to the coastal position of the swamp.--Auth.

3-1083. Graham, Alan, and Charles Heimsch. POLLEN STUDIES OF SOME TEXAS PEAT DEPOSITS: Ecology, v. 41, no. 4, p. 751-763, 5 figs., 4 tables, Oct. 1960, 33 refs.

Pollen associations from 10 cm. intervals in S. Soefje bog (4.7 m. deep), Gonzales County, Texas, are described, and significant forms are illustrated. Pollen grain and spore counts show little fluctuation in relative frequencies of forms, suggesting stable local plant associations much like those in the region today. The bottom bog level yielded a radiocarbon date of 7,820+ 350 years.

Re-study of samples from lower levels of the Gause bog, Milam County, and re-evaluation of studies of bogs in nearby counties, suggests that a cool, moist climate supporting spruce existed in the region prior to the formation of S. Soefje bog. However no marked climatic oscillations, such as previously suggested, seem to be reflected by pollen associations. Instead the cool-moist climate evidently gave way to a warm-moist climate and then gradually to the warm-dry climate which exists today. It is tentatively suggested that the change from cool to warm climates correlates with general warming dated elsewhere as approximately 12,500 B.P.--J.W. Valentine.

3-1084. Kazansky, A.B., and V.N. Kolesnikova. ON THE THERMAL BALANCE OF THE FEDCHENKO GLACIER: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 379-384, 10 figs. incl. map, graphs, 6 refs.

The Fedchenko glacier basin represents the center of present glaciation of the Pamir, covering an overall area of approximately 1,000 km. It is evident that the major portion of the heat received by the glacier surface is spent on evaporation, a smaller amount on melting, while a negligible part of it enters the ice body due to thermal conductivity. Thus, the glacier material in the firn area "prefers to evaporate" which keeps the volume of melted material comparatively small.

This means that if evaporation would be low, the volume of melted material would be several times larger. However, a large portion of the heat goes into evaporation, which retards the melting process. The amount of evaporated material, though, is small because the evaporation heat for snow is almost 10 times greater than the heat needed for melting.

This conclusion agrees with our assumption of the firn area of the glacier being an accumulation zone for precipitation. The material accumulating

here is transferred by the movement of the glacier into its bottom portion, where it feeds, after intensive melting, the rivers issuing from the glacier.--Auth. p. 383.

3-1085. Winkler, Erhard M. INTERPRETATION OF GLACIAL DRIFT FROM INFRARED FILMS: Photogramm. Eng., v. 26, no. 5, p. 773, Dec. 1960.

Preliminary work has been completed in a study to determine the optimum aerial film-filter combination for utilization in identifying and distinguishing a variety of glacial drift. Three small areas in northern Indiana were photographed employing various Wratten filters in combination with Aerographic XX, Kodachrome, Ektachrome-Aero, Camouflage Detection, and Infrared Aerographic film. Maximum soil contrasts were achieved by the use of Camouflage Detection film in combination with a Wratten G yellow filter. Another advantage of this film lies in the fact that foliage is imaged in shades of red, thus preventing confusion of soil patterns with those of vegetation.--J.R. Van Lopik.

3-1086. Craig, Bruce G. SURFICIAL GEOLOGY OF NORTH-CENTRAL DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES: Canada, Geol. Survey, Paper 60-18, 8 p., Map 24-1960 (in pocket), scale 1:1,013,760, 2 tables, 1960, 6 refs.

Surficial geology of an area of about 65,000 sq. mi. bounded by the 65th parallel and Great Bear Lake on the S., by the arctic coast on the N., the 12th meridian on the E., and 124th meridian on the W. The report is based on airphotograph compilation and field data gathered on helicopter surveys and ground observations. A profusion of glacial land forms, moraine ridges (composed mostly of boundary clay till), hummocky moraine, kame hills, drumlins, and eskers were seen. Ice-flow features show that the area was affected by 2 distinct lobes of the retreating ice sheet. E. of Darnby Bay and at the W. end of Coronation Gulf, ice of the northern lobe moved to the SW. Throughout most of the area, ice of the southern lobe moved to the N., NW., and W. Some small proglacial lakes resulted from the blocking of natural drainage lines by the ice front. Marine submergence is indicated by many abandoned strand lines and vast areas of marine silt and clay, in places fossiliferous. Radiocarbon age determinations on shells from 4 localities give indications as to the time the coast became ice free and to the pattern of deglaciation. Several pingos were noted in the northeastern and western parts of the area.--M. Stewart.

3-1087. Terasmae, Jaan. SURFICIAL GEOLOGY OF CORNWALL MAP-AREA, ONTARIO AND QUEBEC: Canada, Geol. Survey, Paper 60-28, 4 p., Map 4-1960 (in pocket), scale 1:63,360, 1960, 9 refs.

Consists of short notes on Cenozoic and mention of Ordovician deposits exposed by the St. Lawrence Seaway construction in the area. Three directions of ice movement are indicated: 1) WNW., 2) NW., and 3) the youngest, from the N. Striae, drumlins, and pebble orientations were used as sources of evidence. Stratigraphically the base of the column comprises Ordovician limestone, shale, dolomite, and sandstone. Surficial deposits are divided into a) deposits of the Champlain sea, b) aeolian sands, c) alluvial deposits, d) Pleistocene and Recent peat and muck. The whole map-area was inundated by the Champlain Sea. As a consequence the alluvial deposits are underlain by marine clay, and marine sand may be underlain by marine clay. Clays containing Yoldia arctica indicate brackish water concitions at the beginning of the Champlain Sea episode. Later on, emergence of the land produced numerous beach ridges and nearshore bars. Fossil and pollen studies are quoted as evidence of age and water depth. Gravel pits and crushed stone quarries have been successfully exploited by the St. Lawrence Seaway project.--M. Stewart.

3-1088. Gadd, Nelson R. SURFICIAL GEOLOGY, UPTON, QUEBEC: Canada, Geol Survey, Paper 60-27, 4 p., Map 15-1960 (in pocket), scale 1:63,360, 1960, 4 refs.

Contains one of a series of adjoining maps of Pleistocene geology of the central St. Lawrence Valley. This area is about 25 mi. S. of Three Rivers (Trois Rivières), Quebec, and adjoins the Yamaska sheet [GeoScience Abstracts 2-2201]. The oldest glacial sediment is the Bécancour till. It was deposited by SW.-moving ice more than 60,000 years ago. Interglacial sediments are rare or poorly developed, but those observed correlate with those in adjoining areas thought to result from an early drainage system comparable with the present St. Lawrence River system. The second glaciation was by the S.-moving Wisconsin ice sheet, which deposited sandy to silty gray till. Drummondville moraine was formed during the retreat of the ice front. During the recession, the entire area was inundated by the brackish waters of the Champlain Sea, and fossiliferous clays were laid down. Subsequent recession of water levels was accompanied by increased current action, and fluvial sands were laid on terraces cut in marine and underlying sediments. Radiocarbon datings on peat and muck of a post-marine period give a minimum age for activity of $9,550 \pm 600$ C^{14} years. Alluvium of fine sand and silt completes the stratigraphic column of the area.--Auth.

3-1089. Arkhipov, S.A. GLACIAL-MARINE DEPOSITS IN THE YENISEY REGION, WEST SIBERIAN PLAIN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 26-32, secs., table, pub. 1960, 13 refs.

Occurrence of glacial-marine deposits in the Yenisey region of the W. Siberian lowland is firmly established. Fossils and the character of the Quaternary rocks in which these fossils were found prove that these rocks were formed as a result of the concentrated action of a transgressing or regressing sea, and deposits of numerous glaciers. At the same time, tectonic movements affected the whole coastal line of the region. A detailed stratigraphic description of the region is given.--LC.

3-1090. Stricklin, Fred L., Jr. DEGRADATIONAL STREAM DEPOSITS OF THE BRAZOS RIVER, CENTRAL TEXAS: Geol. Soc. America, Bull., v. 72, no. 1, p. 19-35, 6 maps, chart, 2 secs., 2 diags., Jan. 1961, 25 refs.

According to a geomorphic investigation, the Brazos River in a 250-mi. segment of its interior valley (Waco to Knox City, Texas) is a degradational stream with diverse channel patterns and unevenly distributed alluvium, and the character of the alluvium indicates that valley deepening was also a dominant trait of the stream during the Pleistocene. This

is indicated chiefly by several diagnostic properties of the alluvium which seem to be directly related to stream degradation acting concurrently with lateral planation and accretion. These properties serve as an excellent basis for interpreting the history of channel migration.

The erodibility of various pre-Tertiary strata, into which the Brazos is presently incised, accounts for differences in stream gradient, channel form, and sedimentary load and largely determines the type of stream pattern developed. Typical patterns of braiding and flood-plain meandering are confined respectively to soft bedrock in the distal upper and lower parts of the valley; incised meanders are developed in resistant strata of the lengthy intervening segment.

Alluvium which expands to form prominent terraces in the more erodible valley segments (2 terraces in the upstream segment and 3 in the downstream segment) indicates extensive lateral planation of the stream during downcutting of soft bedrock. Four diagnostic properties of the alluvium point to such a history: 1) the deposits decrease upward in component size from gravel to terminal silt or clay and represent the successive accumulation during channel migration of bed load, bank, and overbank-flood-plain deposits; 2) the average thickness of the alluvium, about 30 ft., is a function of stream-stage variation and equal to the vertical distance between channel bed and flood plain; 3) the terraces and underlying bedrock surfaces have 2 components of slope: a major cross-valley component related to lateral shifting of the stream and concurrent downcutting and a minor down-valley component imposed by the stream gradient; and 4) the terraces are normally unpaired because lateral planation and bank undercutting have precluded the formation of opposing valley-side counterparts. Interpretations based on these diagnostic properties could have wide application, because the properties should be typical of degradational stream deposits in general.

Several lines of evidence besides that of the alluvium indicate that the "Seymour beds" and younger alluvium immediately W. of Seymour, Texas, are lateral accretions of 2 streams - the northerly shifting Brazos and a westerly shifting former tributary of the Brazos. From the slope of stream-planed bedrock surfaces beneath the alluvium, successive channel positions of the 2 streams are reconstructed and show the pattern of shifting of the tributary, which eventually led to its diversion into the Wichita River system. The limited distribution of lenses of Pearlette ash in the Seymour indicates the approximate position of both streams at the time of a far-reaching ash fall during the middle Pleistocene (late Kansan or early Yarmouthian). According to these indicated positions, the bulk of the alluvium was deposited before the ash fall.--Auth.

3-1091. Holm, Donald August. DESERT GEOMORPHOLOGY IN THE ARABIAN PENINSULA: Science, v. 132, no. 3437, p. 1369-1379, 6 illus., map, Nov. 11, 1960, 17 refs.

The topographic features of the Arabian peninsula are described and illustrated by aerial photographs. About 30% of the 1,060,000 sq. mi. is covered by sand. The sand occupies areas of low relief. The area has a complex wind regime; thus the dunes show a great diversity of shape and size. Gravel plains are very extensive; these were in part, deposited in wetter Pleistocene times. Sabkhahs (saline flats) are often disguised by a thin cover of sand or silt; they are a hazard for vehicles. Their origin is discussed. A number of canyons cut through the central Tuwaiq escarpment are wider at the western, rather than eastern ends, suggesting stream flow contrary to the present eastward direction.--F.P. Glasser.

3-1092. Myers, Arthur J. THE UPPER ROOM OF ALABASTER CAVERN, WOODWARD COUNTY, OKLAHOMA: Oklahoma Geology Notes, v. 21, no. 1, p. 26-32, maps, secs., Jan. 1961, 2 refs.

The Upper Room of Alabaster Cavern has formed in the essentially horizontal Nescatunga gypsum and underlying shale of the Permian Blaine formation and consists of 3 segments: an entrance room, a N. passage, and a S. passage. The entrance room has been modified and enlarged from its original tubular shape by the collapse of blocks of gypsum from walls and roof. The N. passage is a small tubular opening. The S. passage is the largest and retains most of its tubular shape, being only slightly modified by collapse of the roof.

Channeling in the roof of the S. passage has the appearance of inverted entrenched meanders. Three channels were mapped. Two of the channels are from 3 to 6 in. wide. Maximum inverted depth (height) of 111 in. was measured. The width of the meander belt is approximately 30 in., with some tight meander loops. The third channel indicates 2 cycles of erosion, the channel of the second cycle being lower and straighter.

The channeling and tubular shape of the openings in the Upper Room of Alabaster Cavern and streams draining into sinks in the vicinity of the head of the caves indicate a vadose-water origin for the caves.--Auth.

3-1093. Bretz, J. Harlen. BERMUDA: A PARTIALLY DROWNED, LATE MATURE, PLEISTOCENE KARST: Geol. Soc. America, Bull., v. 71, no. 12, pt. 1, p. 1729-1754, 2 maps, chart, diag., 4 secs., Dec. 1960, 13 refs.

During Pleistocene time, the Bermuda Islands repeatedly underwent partial inundation and re-emergence. The land areas were continuously attacked and reduced by rain and ground water but repeatedly renewed, during times of submergence, by deposition of marine limestone and by contemporaneous additions of shore-born and wind-transported carbonate sand, now eolianite. Soils formed under subaerial conditions are now buried beneath later deposits and constitute important stratigraphic markers. The igneous foundation rock appears to have been exposed during some low marine stands, and the former shorelines seem to be recorded by submerged terraces. The major karst features are largely below sea level, and they must date from times of continental glaciations.

Previous writers have assigned eolian accumulation to times of Pleistocene low sea level and soil-making to times of interglacial high sea. Both conclusions are held to be erroneous.--Auth.

3-1094. Scheidegger, Adrian E. MATHEMATICAL MODELS OF SLOPE DEVELOPMENT: Geol. Soc. America, Bull., v. 72, no. 1, p. 37-49, 16 figs. incl. diags., graphs, 5 tables, Jan. 1961, 15 refs.

Various theoretical postulates regarding the origin of degradational slopes have been investigated. These postulates represent specific physical conditions

which can be expressed in the form of nonlinear hyperbolic partial differential equations. A number of such differential equations, corresponding to various possible physical conditions, has been integrated numerically, and the results of the computations are presented. Thus one obtains a number of slope profiles upon which the observational scientists may draw. In every case, a comparison between theoretical and observed slope profiles will ascertain the physical conditions that produced the latter.--Auth.

3-1095. Hill, D.E., and J.C.F. Tedrow. WEATHERING AND SOIL FORMATION IN THE ARCTIC ENVIRONMENT: Am. Jour. Sci., v. 259, no. 2, p. 84-101, 7 figs. incl. 2 illus., 7 tables, Feb. 1961, 28 refs.

In order to depict the nature of the weathering processes operating in the arctic regions, 4 Arctic Brown soil profiles from northern Alaska were studied. Examination of the sand and clay fractions indicates that chemical weathering is in operation; its magnitude, however, is of low order. Acid conditions in the surface facilitate the solution of carbonates, but their removal is incomplete as reprecipitation occurs within the profile. Because of increased concentration of Fe-stained opaque minerals near the surface, oxidation of Fe-bearing minerals was strongly indicated.

On very sandy quartzose profiles, Fe, Al, and Mn are partially mobilized and partially translocated, suggesting a weak podzolic process.

Clay-size minerals consist mainly of hydrous mica, kaolinite, chlorite, quartz, goethite, and feldspar. Hydrous mica, the most abundant clay mineral, was more hydrated at the surface, and goethite was present only in the surface horizon. Alteration of feldspar into a claylike substance was noted, but well-crystallized feldspar persisted in the clay fraction.

A concentration of fines was present in the surface horizon of all Arctic Brown soil profiles. Whether this fine material forms in situ or is a result of aeolian deposition remains a moot question.--Auth.

3-1096. Baker, F.J., and others. SURFICIAL MATERIALS AND SOILS OF PAULDING COUNTY, OHIO: Ohio Jour. Sci., v. 60, no. 6, p. 365-377, 3 figs. Nov. 1960.

Major differences in soils of this area need to be recognized because the influence of respective parent materials on soils developed from them affect management problems which vary considerably from one soil area to another.

During earlier soil surveys, parent materials of the principal dark colored soils have been classified as being derived from lacustrine deposits, glacial till, or combinations of these soil materials.

Completion of a soil survey in Paulding County in 1954 has clarified the kinds of parent material in this and adjoining areas. Hoytville soils (formerly called Brookston) developed from calcareous clay till containing 38 to about 50% of clay. Paulding soils, derived from lacustrine clays more than 42 in. thick over clay till, contain 60 to over 75% of clay. The Latty series was established to include soils of the broad area on which less than 42 in. of lacustrine deposits occur over clay till; they contain 50 to 60% of clay in the subsoil. In eastern Paulding County, Toledo soils developed from lacustrine clays containing 40 to 60% of clay. These deposits overlie the finer textured Paulding soil parent materials.

Several theories have been advanced on the origin of these soil parent materials in the western end of the Lake Plain area in northwestern Ohio.--Auth.

3-1097. Semenova, N.N. A STUDY OF SOIL EROSION BY AERIAL PHOTOGRAPHS: Pochvovedeniye, Soviet Soil Sci., in translation, 1959, no. 5, p. 582-590, 6 illus., pub. 1960, 12 refs.

Soil erosion is widespread in the area surrounding Tsimlyansk reservoir, U.S.S.R. The processes of soil wash-out and linear erosion are closely related to the steepness, shape, and exposure of the slopes, to the nature of the soil-forming parent materials, and to the state of the soil surface (plowed or in sod).

Eroded soils have a rather distinct appearance on aerial photographs, either from changes in the tone of the photographic image or from changes in the nature of the pattern principally by the photographic image of the forms of linear erosion (waterways, eroded ravines, and gullies).

Black-and-white, 1:10,000-scale aerial photographs from a spring survey (Apr.-May) are the most useful for the purposes of identifying eroded soils and forms of linear erosion. The use of large-scale (1:10,000) airphotos permits soil maps of the same scale to be compiled. These soil maps show much detail and accurately locate the soil outlines.--Auth. concl.

3-1098. Skvortsov, A.F. RIVER SUSPENSIONS AND SOILS: Pochvovedeniye, Soviet Soil Sci., in translation, 1959, no. 4, p. 409-416, map, graph, 4 tables, pub. 1960, 17 refs.

In this article the river suspension is considered as an element of geographical landscape, specifically, as a connecting link between the soils of the eroded part of a river basin and those of river valleys and deltas formed on alluvium.

Using the Rion river as an example, the need is demonstrated for a knowledge of the many-sided qualitative characteristics of river suspensions in order to establish the rules governing their formation, particularly for the characterization of soil erosion.

A differentiated approach to the river basin which would account for all factors determining the composition and dynamics of river suspensions is essential. The factors are: geology and geography, hydrological characteristics, climate, vegetation, and the agricultural utilization of land in the river basin.

On the basis of the physiogeographic analysis, it is expedient to introduce a concept of alluvial supply zones in the river and of changes in these zones in the various hydrological periods of the year. An alluvial supply zone must be evident in the basin of any large river. However, it is specifically evident in mountainous rivers, from the influences of vertical zoning.

The knowledge of river suspension composition and of conditions of deposition makes it possible to execute a thorough genetic analysis of the development of soil formations on alluvium. A detailed study of river suspensions is of particular significance for the southern zone of the U.S.S.R. and for the SE. of the European part, where muddiness of rivers and the amount of deposited sediments is highest.

The present methods of investigating river suspensions used in river hydrology must be modified

and improved in accordance with the requirements of argriculture and the possibility of their utilization in soil science.--Auth. concl.

3-1099. Forward, Charles N. SHORELINE CHANGES IN EGMONT BAY AND BEDEQUE BAY, PRINCE EDWARD ISLAND: Canada, Dept. Mines & Tech. Surveys, Geog. Branch, Geog. Paper no. 26, 15 p., 20 illus., 6 maps, 1960.

An investigation of Northumberland Strait shorelines was carried out in 1958 in connection with studies of a proposed causeway between Prince Edward Island and the mainland. The construction of such a barrier would cause increases in tidal range throughout the strait, especially in the vicinity of Egmont and Bedeque bays. Hence, information on shoreline character and rates of retreat is of practical significance in providing a basis for estimating the effects of higher water levels. This paper indicates the general height and composition of the shoreline erosion face and demonstrates with air photos some of the changes in coastal configuration that have occurred during the last quarter century.

Evidence of rapid changes in the shorelines of both bays is apparent. Although the coast is still in a youthful stage, the erosional processes are tending to smooth the shoreline. As a result, the more exposed points suffer severe wave attack, and shoreline retreat is very rapid where low unconsolidated banks are exposed. Rock appears along the shore only in limited sections of the bays. As indicated by the 25-ft. contour, the land rises fairly rapidly inland, except near West Point, Percival River, and Sunbury Cove. Consequently the rate of shoreline retreat will eventually decrease where the erosion face increases in height as the shoreline retreats inland.--From auth. introd. & concl.

3-1100. Steers, J.A. THE COAST OF ENGLAND AND WALES IN PICTURES: 146 p., 167 illus., 18 maps, secs., New York, Cambridge University Press, 1960.

New edition of a book first published in 1948 under the title of A Picture Book of the Whole Coast of England and Wales. Many new air photographs from the collection of Cambridge University have been added, and all illustrations have been reproduced by a different method. A brief introduction is given on coastal landforms in relation to the pictures - cliffs; drowned river valleys; raised beaches, platforms, waterfalls; islands; dunes and marshlands; shingle formations; salt marshes; marsh formation; influence of geologic structure; the preservation of coastal areas. Then follow notes on the plates and a map showing the site of each photograph.

The photographs are arranged as a journey from London via the Channel coast to Land's End, up the Bristol Channel to near Cardiff, then along the coast of S. Wales to the far end of the Tenby peninsula, the Pembrokeshire coast, Cardigan Bay, the Lleyn peninsula to the Menai Strait, Anglesey, the coast of N. Wales, Lancashire, and Cumberland to Solway Firth. The journey recommences at Berwick on the NE. coast of England and follows the E. coast S. to the Thames.

Following the photographs is a regional commentary on each section of the coast, describing the general geology, geomorphology, and coastal changes within historic time. It is accompanied by geologic sketch maps and sections.--A.C. Sangree.

3-1101. Laughton, A.S. AN INTERPLAIN DEEP-SEA CHANNEL SYSTEM: Deep-Sea Research, v. 7, no. 2, p. 75-88, 11 figs. incl. illus., charts, profiles, Oct. 1960, 9 refs.

A system of channels connnecting the Biscay and Iberia plains was discovered in 1958. Two main channels cut through the sill and join after 20 mi. The total length between plains is 50 mi. and the width of the channels varies from 2 to 10 mi. The change of level between plains occurs where the channel first leaves the upper plain. The channel shows a meander formation similar to a subaerial river. Cores show that turbidity currents have been active in the past. Small feeding channels on the Biscay plain converge on the interplain channels.

It is concluded that turbidity currents initiated on the continental shelves and flowing across the Biscay plain can be rejuvenated by the increase in gradient and lateral constriction and flow through to the Iberia plain where they finally deposit their load.--Auth.

3-1102. Laughton, A.S., and others. GEOPHYSICAL INVESTIGATIONS OF A SEAMOUNT 150 MILES NORTH OF MADEIRA: Deep-Sea Research, v. 7, no. 2, p. 117-141, 17 figs. incl. illus., charts, profiles, Oct. 1960, 13 refs.

An elongated seamount rising to 678 fathoms was surveyed by echo-sounding, dredging, photography, magnetic, and seismic methods, the results of which are described. The feature appears to be the result of volcanic extrusion along a fault running obliquely across a broad rise.--Auth.

3-1103. Fairbridge, Rhodes W., and Harris B. Stewart, Jr. ALEXA BANK, A DROWNED ATOLL ON THE MELANESIAN BORDER PLATEAU: Deep-Sea Research, v. 7, no. 2, p. 100-116, 8 figs. incl. illus., 3 charts, profile, Oct. 1960, 56 refs.

The Melanesian border plateau covers an area 1,000 by 200 mi. along the northeastern edge of Melanesia, facing the central Pacific basin, with an average depth of 1,500 fm. (2,700 m.). It trends E.-W., but is broken up into a series of narrow ridges and troughs en echelon trending NW.-SE., each approximately 250 mi. long and 100 mi. from ridge crest to crest. The troughs rarely exceed 2,200 fm. (4,000 m.) in depth. Some are closed basins and others open out in a funnel shape, sloping gradually down into the central Pacific basin (2,700 fm. or 5,000 m.). Although the border plateau is bounded by the "andesite line" there is an anomalous absence of any belt of deep trenches on the basin margin. The echelon ridges of the plateau are mostly less than 1,000 fm. (1,800 m.) deep. They are capped by a few small volcanic islands and a large number of slightly submerged (10-15 fm. or 18-27 m.) atolls of dead, "drowned" corals. Alexa Bank is a characteristic example. The cause of coral death is a mystery; volcanism and foul upwelling are possible explanations.--Auth.

3-1104. Rikhter, G.D. REPORT ON THE WORK OF THE GEOGRAPHIC-EXPLORATION PARTY OF THE KOLA EXPEDITION OF 1930: Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 2, p. 147-174, 3 maps, profile, 5 secs., 3 tables, Feb. 1961.

The Niva river valley extending from lake Imandra

to the Kandalaksha gulf on the Kola peninsula has a complex geologic and geomorphic history of Tertiary to Recent faulting, uplift, glaciation, and marine deposition and erosion. The area's crystalline basement of biotite and hornblende gneisses was folded and faulted, but only the faulting is reflected in the existing alignment of streams and lakes. Quaternary alluvium, as thick as 80 m., was deposited in association with 2 principal SE.-moving glaciers. Several terraces resulted from intermittent lowering of glacial lakes as lower outlets were developed or as the rate of downcutting varied in response to lithologic variations of stream channels. Continuing uplift of the Kola peninsula is an additional complex factor in the geomorphologic development of the area.--M. Russell.

3. STRUCTURAL GEOLOGY

See also: Areal and Regional Geology 3-1070; Stratigraphy 3-1121; Geophysics 3-1216, 3-1234.

3-1105. Harris, John F., and others. RELATION OF DEFORMATIONAL FRACTURES IN SEDIMENTARY ROCKS TO REGIONAL AND LOCAL STRUCTURE: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1853-1873, 13 figs. incl. 5 illus., 5 maps, 2 secs., Dec. 1960, 19 refs.

Surface studies of fractures, on both local and regional compressional structure, show a definite relation between the trend of the fractures, their density, and the structure on which they occur.

The susceptibility of any stratum to fracturing is dominantly controlled by the thickness and lithologic character of the stratum. These factors are evaluated and used to convert fracture data taken on beds of various lithologic character and thickness to a datum bed. Fracture-pattern and iso-fracture maps are then constructed from these data.

These methods were applied in the field to 2 areas in Wyoming: the Goose Egg dome of local extent, and the Sheep Mountain area, of regional extent. These areas show that the trend and concentration of fractures are controlled by the compressional structure configuration.--Auth.

3-1106. Hardin, Frank R., and George C. Hardin, Jr. CONTEMPORANEOUS NORMAL FAULTS OF GULF COAST AND THEIR RELATION TO FLEXURES: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 238-248, map, 9 secs., graph, table, Feb. 1961, 22 refs.

Faults along which movement was contemporaneous with sediment deposition are common in the post-Eocene beds of the Gulf Coast. These faults have been called "depositional faults," "progressive faults," and other names, but the term "contemporaneous fault" has priority in geological literature and should be used to describe faults of this type. Increase in the thickness of beds on the downthrown side of a fault when compared with the same beds on the upthrown side is generally considered to be evidence for a contemporaneous fault. In general, the younger the sediments, the more numerous are contemporaneous faults. Faults of this type in the Gulf Coast are largely confined to a belt paralleling the coast line and located downdip from the Vicksburg (Oligocene) flexure. Since movement occurs contemporaneously with deposition, contemporaneous faults control sedimentation in areas affected by the movement. The attitude of the depositional surface of the downthrown fault block largely determines the distribution of sediments over the fault block.

A flexure is a zone downdip from which the rate of dip and thickening of sedimentary beds is accentuated. The writers believe that flexures result from deposition of sediments across the shelf break. Flexures affect most Cenozoic beds in the Gulf Coast, and most flexures are marked by contemporaneous faults of regional extent which tend to accentuate the effect of a flexure on sedimentation.

Sedimentation rate in the Gulf Coast has been steadily increasing since Cretaceous. Maximum sedimentation rate has risen from 2 cm. per century for Eocene sediments to 8.1 cm. per century for Miocene sediments and 12.2 cm. per century for Pleistocene and Recent sediments. The prevalence of contemporaneous faults in post-Eocene beds is apparently related to this increase in rate of sedimentation and subsidence. Regional contemporaneous faults were formed along zones of flexure as a result of slumping, but contemporaneous faults associated with local structures are the result of normal structure-forming tectonic forces at work in the Gulf Coast during periods of rapid sedimentation.--Auth.

3-1107. Higgins, Charles G. SAN ANDREAS FAULT NORTH OF SAN FRANCISCO, CALIFORNIA: Geol. Soc. America, Bull., v. 72, no. 1, p. 51-68, 5 maps, profile, graph, Jan. 1961, 28 refs.

N. of San Francisco the width of the San Andreas fault zone is difficult to determine. Failure to recognize slivers within this zone apparently led some earlier writers to false conclusions about stratigraphic relationships along parts of the fault trace.

Previous authors' statements that cumulative right-lateral displacement along the San Andreas fault measures hundreds of miles since Jurassic time are based chiefly on alleged stratigraphic relationships S. of San Francisco. Attempts to relate amounts of displacement along the fault S. of San Francisco to amounts N. of San Francisco (and vice versa) may be invalidated by possible distribution of San Andreas movement along one or more other faults that may branch from or cross the San Andreas fault N. of San Francisco.

N. of San Francisco the San Andreas fault was active before middle Pliocene time, but as yet the evidence seems insufficient to allow determination of either the type or amount of pre-middle Pliocene displacement. Present positions on opposite sides of the fault trace of areas that appear to have been marine entrances to middle Pliocene basins E. of the fault trace suggest that right-lateral displacement along the San Andreas fault N. of San Francisco has not exceeded 15 mi., more likely has amounted to 4 to 10 mi., and possibly has not exceeded 1 to 1 1/2 mi. since middle Pliocene time. During the same time, vertical movements have raised the E. side of the fault about 500 ft. relative to the W. side in some areas, possibly everywhere N. of Bolinas.--Auth.

3-1108. Wood, Gordon H., Jr., and Thomas M. Kehn. SWEET ARROW FAULT, EAST-CENTRAL PENNSYLVANIA: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 256-263, 6 maps, secs., table, Feb. 1961, 3 refs.

The Sweet Arrow fault between Swatara Gap and New Ringgold is a major structural element separating overturned rocks to the N. from a normal sequence of rocks to the S. The fault also probably is responsible for the numerous anomalous stratigraphic and structural relations from New Ringgold E. to the Lehigh River and from Swatara Gap W. to the Susquehanna River.

From surface reconstructions the Sweet Arrow fault is interpreted as a thrust which dips S. at 40°-70° and has a throw that may locally be as great as several thousand feet.--Auth. concl.

3-1109. Hough, Van Ness D. PHOTOGEOLOGIC TECHNIQUES APPLIED TO THE MAPPING OF ROCK JOINTS: West Virginia Geol. & Econ. Survey, Rept. Inv. no. 19, 21 p., 5 illus., 6 maps, diag., 1960, 11 refs.

Fracture traces, the geomorphic expressions of bedrock jointing visible on aerial photographs, are discussed in relation to their types of occurrence, mode of development, and methods of mapping. Study of the fracture trace pattern of the Morgantown, West Virginia, 15-min. quadrangle reveals 8 different joint sets, including coal cleat, which can be related to the present and past positions of the axis of the Chestnut Ridge anticline.

An attempt to find a correlation between the fracture trace pattern mappable on aerial photographs and recognizable stratigraphic units was unsuccessful, but not ruled out as a possibility with refined techniques and more accurate plotting equipment.

Density analysis of the fracture trace pattern developed over this same anticlinal structure shows the coincidence of a zone of high density with the axial region and decreasing density with the flanks of the fold. This suggests an exploratory technique useable in areas where very few or no outcrops exist or where the operation of a field party would be impractical or impossible.--Auth.

3-1110. Hodgson, Robert A. REGIONAL STUDY OF JOINTING IN COMB RIDGE-NAVAJO MOUNTAIN AREA, ARIZONA AND UTAH: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 1, p. 1-38, 26 figs. incl. 11 illus., 4 maps, 2 charts, diags., Jan. 1961, 60 refs.

The spatial relations of joints and, in particular, structural details of individual joints, offer clues of their origin. Important features of joints have been largely neglected in previous joint studies, and the present study is an attempt to determine more closely the true nature of joints in sedimentary rocks and to suggest a mode of origin more in line with field observations than is present theory.

The study area comprises about 2,000 sq. mi. of the Colorado Plateau in northeastern Arizona and southeastern Utah where sedimentary rocks ranging from Pennsylvanian to late Cretaceous are exposed.

A simple, nongenetic joint classification is presented based on the spatial relations of joints and the plumose structures on joint faces. Joints are grouped as systematic or nonsystematic with cross-joints defined as an important variety of nonsystematic joints.

Plumose structures on joint faces indicate that joints are initiated at some structural inhomogeneity within the rock and propagated outward, thus precluding movement in the direction of the joint faces at the time of formation. Spatial relations of systematic joints point to formation at or near the earth's surface in a remarkably homogeneous stress field.

The regional joint pattern is composed of a complex series of overlapping joint trends. The pattern as a whole extends through the entire exposed rock sequence. Intersecting joint trends have no visible effect on each other and may terminate independently in any direction. Each joint trend of the regional pattern crosses several folds of considerable magnitude but does not swing to keep a set angular relation to a fold axis as the axis changes direction.

Hypotheses stating that joints are related genetically to folding are rejected for the mapped area. The shear, tension, or torsion theories of jointing require that only 1 or 2 sets of joints be considered as the result of a particular stress condition. Where more sets are present, different stress conditions must be postulated for each set or pair of sets believed to be related genetically. The joint pattern in the mapped area cannot be interpreted in such terms without making these assumptions. Alternatively, in accord with theoretical and experimental evidence, semi-diurnal earth tides are considered as a force capable of producing joints in rocks through a fatigue mechanism. Field observations suggest that joints form early in the history of a sediment and are produced successively in each new layer of rock as soon as it is capable of fracture. The joint pattern in preexisting rocks may be reflected upward into new, nonjointed rock and so control the joint directions.

Much critical data from areas with different geologic histories are needed before a quantitative evaluation of this hypothesis can be made. The question of the ultimate origin of the regional joint pattern and its genetic relation, if any, to other structure at depth cannot be answered on data now available.--Auth.

3-1111. Vine, James D. RECENT DOMAL STRUCTURES IN SOUTHEASTERN NEW MEXICO: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1903-1911, 4 illus., 2 maps, 4 diags., Dec. 1960, 4 refs.

Domal structures that range from several hundred to several thousand feet in diameter are present in southeastern New Mexico. The structures examined are characterized by brecciated cores of stratigraphically displaced rock and by the deformation of rocks apparently including those as young as the Recent caliche.

The stratigraphic sequence of the region is characterized by as much as several thousand feet of saline rocks, chiefly halite and anhydrite belonging to the Castile, Salado, and Rustler formations (from oldest to youngest) of late Permian age overlain by a few hundred feet of red siltstone and sandstone belonging to the Pierce Canyon red beds of Permian or Triassic age and the Santa Rosa sandstone of Triassic age.

Although these domal structures occur as abundantly as 6-8 per sq. mi. locally along the Pecos River, the best exposed are a group of 4 located 18-20 mi. E. of Carlsbad adjacent to the U. S. Highway 62 and 180. These 4 structures involve the doming of rocks as young as Recent caliche and contain cores of brecciated Santa Rosa sandstone in fault contact with Pierce Canyon red beds. Although the domal structures are similar in some respects to those attributed to an igneous or volcanic origin or salt intrusion in other areas, they are thought to be more closely related to sinkholes modified by later deformation. It is suggested that they may have originated as circular sinkholes that resulted from removal of

anhydrite in the Rustler formation. The collapse of insoluble rocks into the sink formed a brecciated core. The domal structure was produced later. Three possible mechanisms for the later deformation are considered: differential solution of salt, intrusive flow of salt, and alteration of anhydrite to gypsum.--Auth.

3-1112. Pospelov, G.L. THE "HEARTH ZONE" OF THE EARTH'S CRUST, "MAGMATOGENE CROWN," "AREAS OF IGNEOUS ACTIVITY," AND "STRUCTURAL ASSOCIATIONS OF INTRUSIONS": Akad. Nauk SSSR, Izvestiya, in translation, 1959, no. 3, p. 13-25, 4 maps, pub. 1960, 17 refs.

This paper presents for discussion some hypothetical considerations on the regional structural units of igneous activity, based on an analysis of well-known facts. In addition, a concept is developed of a "hearth zone" at the base of the earth's crust regulating plutonic and tectonic phenomena.--Auth.

3-1113. Haites, T. Binnert. PERSPECTIVITIES IN THE SOLAR SYSTEM: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 12, p. 345-362, 6 figs., 2 tables, Dec. 1960, 50 refs.

The stations of the planets on a radius of the solar system appear to be perspectively related to the absolute dates of terrestrial diastrophisms and probably also to the spacing of the discontinuities in the earth's interior and atmosphere. Such a relationship would point to cosmic forces as the cause of terrestrial orogenies and discontinuities; also it would follow that the planets were born in the order of their increasing distances from the sun and that they are much younger than is generally accepted. It is believed that the mass redistributions accompanying their births disturbed the existing gravity regime of the solar system and induced a new one. On the preexisting planets the gravitational perturbations caused diastrophisms and the development of discontinuities. On earth this hypothesis would account for 6 orogenic sequences. Of the 5 discontinuities which could have developed in its interior, 3 are characterized by wave velocity changes and a fourth has been interpreted as a phase transition zone.

Perspectivities are governed by simple cross-ratios. Thus, given the stations of the planets and the absolute dates of 3 major orogenic events, other diastrophisms can be found by interpolation and extrapolation. Similarly, the depths of 3 first-order discontinuities would determine the spacing of other transition zones.--Auth.

3-1114. Menard, Henry W. THE EAST PACIFIC RISE: Science, v. 132, no. 3441, p. 1737-1746, 5 maps, sec., diag., profile, Dec. 9, 1960, 10 refs.

Exploration of the Pacific floor discloses a vast low bulge 13,000 km. long, extending between Mexico and New Zealand. It averages 2,000-4,000 km. wide, and has an average relief of 2-3 km. It is broader, has gentler slopes, and is less faulted near the crest than the mid-Atlantic ridge. The crest of the rise coincides with the known distribution of shallow earthquake epicenters. The crust is generally thinner over the rise than over the Pacific floor generally. The crest is marked by abnormally high heat conductivity ($2\text{-}8 \times 10^{-6}$ cal./cm.^{2}/sec.), the flanks by low conductivity ($0.14\text{-}0.97 \times 10^{-6}$ cal./cm.^{2}/sec.). The relationship between the rise and the complex E. Pacific fracture system is discussed. Tentative theories of origin of the rise are reviewed. --F.P. Glasser.

3-1115. Osterwald, Frank W. CRITICAL REVIEW OF SOME TECTONIC PROBLEMS IN CORDILLERAN FORELAND: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 219-237, 2 illus., 2 maps, 5 secs., Feb. 1961, 116 refs.

The Cordilleran foreland is a single large tectonic unit that includes the Colorado Plateau, the Southern Rocky Mountains, the Wyoming basin, and parts of the Great Plains and the Middle Rocky Mountains physiographic provinces. Most structures within the foreland are analogous in size, configuration, and trend, and the tectonic framework of the foreland is in sharp contrast to that of the adjoining Cordilleran geanticline. Many faults that cut rocks of Paleozoic and Tertiary age in the foreland, formerly interpreted as overthrusts, are related to recurrent and preponderantly vertical movement along Precambrian basement structures. Such vertical movement has produced most fold and fault structures, and by repeated deformations of old (Precambrian) structures even relatively young Tertiary rocks are slightly deformed and jointed.--Auth.

3-1116. Slavin, V.I. THE TECTONIC HISTORY OF THE WESTERN UKRAINE IN CONNECTION WITH A TECTONIC DIFFERENTIATION OF THAT PROVINCE: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 26-34, 3 maps, pub. 1960, 18 refs.

The following tectonic provinces and zones are suggested for a modern tectonic map of the western provinces of the Ukraine.

I. Pre-Riphean Platforms. The Russian platform, with the Ukrainian shield and Belorussian platform, separated by the difference in their position and in the basement structure.

In the structure of the sedimentary mantle and the history of the post-Riphean development, the Russian platform is divided into: a) Paleozoic slopes of the shield, complicated by faults and folds; b) the Lvov Cretaceous trough, a Mesozoic platform-type structure, with a Jurassic to Cretaceous thickness of as much as 1,000 to 1,200 m., inherited from a Paleozoic margin syneclise. The trough was initiated in the Jurassic; its development was particularly intensive and came to an end in the Upper Cretaceous.

II. Folded Provinces. 1) The Caledonian, Hercynian, and post-Hercynian folded provinces, present in the western Ukrainian S.S.R., are not shown on the map, because they make up the lower structural levels and are not expressed at the surface. 2) The Alpine folded province, with the following tectonic zones: a) The main anticlinorium, i.e., the central zone of the Carpathian folding, initiated in the Liassic and completed in the Cretaceous. b) The central Carpathian megasynclinorium consisting of 3 subzones: Poloninskiy synclinorium, Gorgan-Pertosh anticlinorium, and central synclinorium. This zone underwent considerable Cretaceous and Paleogene subsidences and a terminal Paleogene folding. c) The outer anticlinorium (end of Paleogene to beginning of Neogene), marked by a system of tectonic scales produced by an overthrust (nappe), as much as 10 km. wide, over a fairly flat zone of the Cis-carpathian foredeep. d) The Miocene Transcarpathian interior trough, with Neogene sediments 8 to 10

km. thick, folded into gentle folds and faulted. e) The Ciscarpathian foredeep divisible into 3 zones, on the basis of the time and the history of their formation: the outer, a platform limb; the central and the interior, a geosynclinal limb.

Migration of the folding movements within a geosynclinal province occurred at each orogenic stage, proceeding from the interior of the geosyncline to the platform. Thus, during the Paleozoic mountain-making stage, the Caledonian folding province was located in the inner Carpathians; the Hercynian included the zone bordering on the outer Carpathians; finally, the post-Hercynian movements were best expressed in the outer Carpathians, at the boundary with the Russian platform.

The Alpine folding represented a new cycle. The ancient Alpine (Cretaceous) folding was most intensive in the main anticlinorium zone, the Oligocene, in the central Carpathian structural zone, and post-Oligocene in the outer anticlinorium. The outer and the inner zones of the Ciscarpathian foredeep, in that order, were formed in the Miocene.--Auth., p. 33.

3-1117. Balukhovsky, N. F. NEW DATA ON THE GEOLOGIC STRUCTURE AND DEVELOPMENT OF THE DONBAS PERIPHERY: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 78-89, 4 figs. incl. 2 maps, pub. 1960, 7 refs.

Structural development of the Donets basin is traced from a Devonian marine province, through downwarping as a result of Hercynian diastrophism, migration of salt under static pressure toward crests of endogenous structures and deep faults, to the eventual formation of complex salt structures from magmatic pressure and stresses. Gas explosions were a factor in the sporadic distribution of salt formations. Orogenic upheaval apparently shifted the maximum sedimentation zone several times, and salt intrusions also responded to these shifts. The great Donbas transverse downwarp is compared to the Wichita system of the United States.--A. Eustus.

3-1118. Novikova, A.S. THE PROBLEM OF THE TECTONIC POSITION OF THE RIPHEAN VOLCANICS ON THE RUSSIAN PLATFORM: Akad. Nauk SSSR, Isvestiya, Geol. Ser., in translation, 1959, no. 1, p. 5-21, map, 4 tables, pub. 1960, 31 refs.

The development of tectonic forms in the sedimentary mantle of the Russian platform began with the formation of narrow troughs, breaking the crystalline foundation into several large blocks, with a series of small crystalline ridges formed along the eastern and southwestern rim of the platform, separated by deep depressions filled with sediments. The Riphean volcanics [Proterozoic] are best developed along the edges of the Russian platform and on the flanks of the troughlike downwarps.--Auth.

3-1119. Said, Rushdi. TECTONIC FRAMEWORK OF EGYPT AND ITS INFLUENCE ON DISTRIBUTION OF FORAMINIFERA: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 2, p. 198-218, 4 maps, 3 secs., table, Feb. 1961, 59 refs.

Results of micropaleontological studies of numerous sections from many localities and different ages in Egypt suggest that tectonics control the appearance and areal distribution of species. The movements that affected the stable shelf are epeirogenic, originating wide-scale transgressions and regressions that cause rock facies and associated biological assemblages to shift gradually in the direction of the new shore. Epeirogenic domes of this belt are big structures that produce diastems or at most unconformities without visible angular discordances. The distribution of rock facies as well as faunas around these structures is uniform and rock lines are almost time-parallel. Several basins of this belt are recorded but the best known of these is that of the Gulf of Suez graben which shows a pattern of distribution of foraminiferal species that seems to be directly connected with the degree of tectonic activity exhibited by different parts within this basin.

The mobile belt was most probably overlapped by seas throughout most of its geologic history. The distribution of rock facies and their biological assemblages is not, therefore, connected with transgressions or regressions but rather with the relative position of the locality to the numerous highs that traversed this belt throughout its history. Structures are small, of compressional origin, and with varying degrees of activity on their sides. They have their inception at different ages. This produces complex patterns of areal and vertical distribution of Foraminifera.--Auth.

4. STRATIGRAPHY AND HISTORICAL GEOLOGY

See also: Areal and Regional Geology 3-1066, 3-1068, 3-1073, 3-1076; Geomorphology 3-1089; Structural Geology 3-1118; Paleontology 3-1163, 3-1164; Mineralogy 3-1266, 3-1271; Igneous and Metamorphic Petrology 3-1282; Sedimentary Petrology 3-1310, 3-1311, 3-1312, 3-1316, 3-1317, 3-1321, 3-1322; Fuels 3-1352, 3-1365.

3-1120. Elias, Maxim K., and Carl C. Branson. RUSSIAN STRATIGRAPHIC NAMES: Oklahoma Geology Notes, v. 20, no. 11, p. 287-289, Nov. 1960.

The current usage of Russian stratigraphers in categories of rock and time divisions is tabulated and endings of gender discussed. The Russian form of the names of major stratigraphic units is given, followed by transliteration and by English equivalent. Some rock names are similarly tabulated.--C. C. Branson.

3-1121. Plaksenko, N.A. CERTAIN STRUCTURAL FEATURES OF PRECAMBRIAN METAMORPHICS OF THE KURSK MAGNETIC ANOMALY (K.M.A.), THEIR CAUSES AND STRATIGRAPHY SIGNIFICANCE: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 46-62, 13 figs., incl. map, pub. 1960, 5 refs.

After an analysis of possible causes for a regular alteration of rocks in a standard section, the author separates 2 main facies in the middle division of the K.M.A., a magnetic and a hematitic. Their description and the distribution areas within the northeastern K.M.A. belt are given.

The investigated quartzites belong to the oxide facies of the over-all sedimentary Fe ore cross section which contains a magnetite (more shallow) and a hematite (deeper facies).

The maximum and almost exclusive development of the magnetite facies takes place E. of the synclinorium axis. The hematite facies, on the other hand, has been developed mostly W. of the axis. Thus,

going from W. to E. and SE., hematite facies (hematite-magnetite quartzites) change to the magnetite (magnetite quartzites) alternating with terrigenous facies (metashales). The shoreline of the deposition basin lay somewhere E. of the easternmost branches of the magnetic anomaly.

The data extant indicate that the hematite facies is best developed within certain districts of the southwestern K.M.A. belt (Gostishchevo, Yakovlev, Veretenino). This points to a general westerly deepening of the sedimentary basin.--From auth. concl.

3-1122. Sheynmann, Yu. M. STRATIGRAPHIC POSITION OF THE SINIAN COMPLEX: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 22-25, pub. 1960, 10 refs.

No international agreement has been reached on classification of the late Precambrian. The Soviet Interdepartmental Stratigraphic Committee has decided to give the whole series of these deposits the name of Sinian complex (series). Lithologically these rocks are similar to the Paleozoic layers, but paleontologically they differ greatly. The author describes similar rock formations all over the world and concludes that there cannot be a definite delimitation of these rocks. He defines this series rather by its absolute age (700 to 800 million years) than by its stratigraphic characteristics.--From LC.

3-1123. Pitt, William D. WHAT LIES BENEATH THE LUKFATA SANDSTONE?: Oklahoma Geology Notes, v. 20, no. 11, p. 290-291, map, Nov. 1960, 8 refs.

The oldest exposed rock in the Ouachita Mountains of Oklahoma is the Lukfata sandstone [Cambrian?], a unit which is correlative with rocks as young as the Simpson group or with rocks as old as the middle Arbuckle. A test well is recommended to determine the thickness and nature of the sedimentary rocks beneath the Lukfata. Economic reasons are cited for drilling this well.--Auth.

3-1124. Bridges, Luther W., and Ronald K. DeFord. PRE-CARBONIFEROUS PALEOZOIC ROCKS IN CENTRAL CHIHUAHUA, MEXICO: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 1, p. 98-104, 3 figs. incl. illus., map, table, Jan. 1961, 30 refs.

Nearly 2,000 ft. of pre-Carboniferous rock ranging in age down to and including the Early Ordovician have been discovered. This rock has undergone considerable structural deformation, predominantly folding, but regional metamorphism has not proceeded further than recrystallization of the limestone.

In the southeastern part of the range, he has found an estimated 2,000 ft. of Pennsylvanian and Permian rock, much of it Wolfcampian.

The total thicknesses of Paleozoic rocks exposed in Texas at Marathon, Shafter, Van Horn, and El Paso, and in Chihuahua at Mina Plomosas are approximately as follows:

	Total Paleozoic (Feet)	Pre-Carboniferous (Feet)
Marathon	25,000	2,500
Shafter	9,000	Not exposed
Van Horn	3,000	1,200
El Paso	5,400	2,700
Mina Plomosas	4,000	1,800

In the Plomosas vicinity as at El Paso both thickness and composition indicate shelf deposits.

The Plomosas formation near Mina Plomosas is about 5,000 ft. thick, including about 4,000 ft. of Paleozoic and 1,000 ft. of Jurassic rock. The Pb and Zn deposits are in the Jurassic part.--Auth. summ.

3-1125. Huffman, George G., and John M. Starke, Jr. A CHAZYAN FAUNULE FROM THE LOWER TYNER, NORTHEASTERN OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 10, p. 268-271, pl., Oct. 1960, 8 refs.

The Ordovician system in northeastern Oklahoma comprises 6 formations. In ascending order these are: Cotter dolomite, Burgen sandstone, Tyner shales and dolomite, Fite limestone, Fernvale limestone, and Sylvan shale. The Cotter dolomite is assigned to the Canadian series, the Burgen-Tyner-Fite sequence to the Chazyan and Black River, and the Fernvale-Sylvan to the Cincinnatian.

Precise correlation of the Burgen-Tyner-Fite sequence with the Simpson of the Arbuckle region has long been conjectural. Recent faunal evidence supports a Chazyan assignment of the lower part of the Tyner and suggests its equivalency to the Oil Creek formation. This places the Burgen sandstone in the stratigraphic position of the Oil Creek sandstone. The upper part of the Tyner resembles the Bromide, and the overlying Fite is compared with the Bromide "dense" or Corbin Ranch formation.--G.G. Huffman.

3-1126. Burtman, V.S., and V. Ya. Medvedev. NEW DATA ON THE AGE OF THE ARMASU FORMATION, NORTHERN TIAN-SHAN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 88-90, map, pub. 1960, 2 refs.

The volcanic-sedimentary Aramsu suite in the Susamyr river basin (Kirgiz S.S.R.) and on the southern slope of the Kirgiz ridge is identified as Upper Ordovician.--M. Russell.

3-1127. Prokofev, V.A. THE COMPOSITION AND STRATIGRAPHIC SIGNIFICANCE OF THE UPPER DEVONIAN PELECYPOD ASSEMBLAGES IN THE CENTRAL VOLGA-URAL PROVINCE: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 100-103, pub. 1960, 7 refs.

Pelecypod fossils are established as a means of defining stratigraphic subdivisions in the Upper Devonian (beginning with the Frasnian substage) of the central Volga-Ural province. Foremost among index fossils proved to be those of genus Buchiola, with 14 forms in wide distribution, of frequent occurrence, and in fair preservation. A number of middle Famennian forms are common also to the correlative Naples beds of North America.--A. Eustus.

3-1128. Huffman, George G., and John M. Starke, Jr. NOEL SHALE IN NORTHEASTERN OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 7, p. 159-163, 2 illus., July 1960, 13 refs.

History of the usage of the terms of Chattanooga, Eureka, Noel, and Sylamore is reviewed. It is proposed that the term Chattanooga formation be retained for Late Devonian-Early Mississippian shale and sandstone lying immediately below the St. Joe group in northeastern Oklahoma and that the Chattanooga formation be divided into 2 members, the lower, or Sylamore sandstone member, and the upper, or Noel Black shale member.--G.G. Huffman.

3-1129. Manukalova-Grevenyuk, M. F. STRATIGRAPHIC DIFFERENTIATION OF THE DONBAS LOWER CARBONIFEROUS, BY MICROFAUNA: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 91-93, pub. 1960.

Study of microfauna permits the classification of lower Carboniferous deposits of the western Donets basin into 32 local series. Faunal distinctions from one series to another also shows changed conditions of sedimentation in this series.--From LC.

3-1130. Halbertsma, H. L., and Frank L. Staplin. THE MISSISSIPPIAN-PENNSYLVANIAN BOUNDARY FROM THE PEACE RIVER AREA TO THE WILLISTON BASIN: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 12, p. 363-373, 3 maps, chart, 5 secs., Dec. 1960, 24 refs.

This paper presents correlations for the Upper Mississippian and Pennsylvanian rocks of Alberta and the Williston basin. Subsurface sections in the Williston basin and the Peace River area and outcrops in the Front Ranges of the Rockies are illustrated, and recent fossil data are considered.--Auth.

3-1131. Barrett, Edward. MISSISSIPPIAN OR PENNSYLVANIAN: THAT IS THE QUESTION: Shale Shaker, v. 11, no. 2, p. 14-17, Oct. 1960, 3 refs.

The problems of Mississippian and Pennsylvanian correlations are briefly discussed with a view toward summarizing some of the general, regional aspects affecting Oklahoma and environs. This is a subjective discussion in defense of one school of thought as opposed to the seemingly indiscriminate use of local details to explain regional factors. Mainly, an appeal is made for more deliberation and deeper consideration of the geologic principles involved before relegating the excellent work of early workers to the realm of obsolescence.--Auth.

3-1132. Bross, Gerald L. DISTRIBUTION OF LAYTON SANDSTONE (PENNSYLVANIAN), LOGAN COUNTY, OKLAHOMA: Shale Shaker, v. 11, no. 2, p. 2-12, 6 maps, 2 secs., table, Oct. 1960, 14 refs.

The Layton sandstone is Missourian in age and belongs to the Skiatook group. Both the Cottage Grove and Layton sandstones occur as lenticular bodies that produce oil from structural and stratigraphic traps. Approximately two-thirds of the area under study is covered by the lower Cottage Grove sandstone which ranges from 0 to 50 ft. The Layton sandstone generally increases in thickness northward.

The Hogshooter limestone is a thin oölitic limestone that grades laterally into a medium-grained sandstone locally and produces small amounts of oil.

All structures in this area trend approximately NW.-SE. and are associated with the Nemaha ridge. The Pennsylvanian sandstones offer the most promising objectives in the way of future production. They are found at relatively shallow depths and, where productive, provide prolific reservoirs.

The Layton sandstone appears to have been deposited in an unstable area where there was fluctuation of sea level as shown by the lenticular shape of the sand bodies and variation in lithology. The sand bodies do not conform to the structure except in the western part of the thesis area, where they are controlled by the Nemaha ridge. This accounts for the erratic distribution of the Layton sandstone in the western part of Logan County.--C. E. Branham.

3-1133. National Research Council, Committee on Stratigraphy, Permian Subcommittee. CORRELATION OF THE PERMIAN FORMATIONS OF NORTH AMERICA: Geol. Soc. America, Bull., v. 71, no. 12, pt. 1, p. 1763-1805, fold. chart, 2 secs., Dec. 1960, 485 refs.

The chart indicates the present stratigraphic classification of the Permian rocks in each important area of outcrop in North America and the time relations of the deposits in the several areas as now understood. Annotations in the text suggest the evidence for many of the correlations and point out unsolved and controversial problems.--Auth.

3-1134. Branson, Carl C. PROPOSED AMERICAN STANDARD OF EARLY PERMIAN(?) ROCKS, A CENTURY-OLD CONTROVERSY: Oklahoma Geology Notes, v. 20, no. 9, p. 229-235, 2 maps, table, Sept. 1960, 7 refs.

Credit for recognition of Permian rocks in Kansas was claimed by Swallow, and by Meek and Hayden. The rocks and fossils thought to be Permian are Sakmarian in age, a division not then considered Permian by any geologist. The long and bitter controversy prevented recognition of these Kansas rocks as the American standard, and they have recently been termed Wolfcampian.

For many reasons the Wolfcamp is an unsuitable standard. It is suggested that the name Lyon, taken from the name of Lyon County, Kansas, be used for the series.--Auth.

3-1135. Ham, William E., and Louise Jordan. A PERMIAN STRATIGRAPHIC SECTION IN WEST-CENTRAL OKLAHOMA: Oklahoma Geology Notes, v. 21, no. 1, p. 4-9, sec., Jan. 1961, 7 refs.

Post-Flowerpot Permian rocks are 1,780 ft. thick in a subsurface composite section from Beckham and Washita counties, W.-central Oklahoma. The Quartermaster formation is composed of the Elk City member above and the Doxey shale member below. Normal thickness is 375 ft., the top being everywhere eroded. The underlying Cloud Chief formation is dominantly sandstone, siltstone, and silty shale. At or near the base it is a locally thick evaporite unit of gypsum and anhydrite. The formation is 430 ft. thick. Below the Cloud Chief is the Whitehorse group, 385 ft. thick, which consists of red gypsiferous fine-grained sandstone and silty shale. The underlying Dog Creek shale is 135 ft. thick. The Dog Creek and the underlying Blaine evaporites are complementary formations, each being thicker where the other is thinner. On the outcrop the Dog Creek consists essentially of reddish-brown shale, whereas the Blaine is about 75% gypsum, 5% dolomite, and 20% interbedded shale.

The normal thickness of the Blaine on the outcrop is approximately 175 ft. in southwestern Oklahoma, but in the subsurface of Beckham County, the formation is as much as 480 ft. thick, the upper half being primarily salt and the lower half salt and anhydrite. Thin salt beds are present in the Blaine formation in subsurface in other parts of western Oklahoma, but this area in Beckham County is underlain by a local basin of thick salt accumulated during Blaine time.--L. Jordan.

3-1136. Stevenson, I. M. NEW OCCURRENCES OF TRIASSIC SEDIMENTARY ROCKS IN CHEDABUCTO BAY AREA, NOVA SCOTIA: Geol. Soc.

America, Bull., v. 71, no. 12, pt. 1, p. 1807-1808, map, Dec. 1960, 2 refs.

Several outliers of sedimentary rocks of Triassic age have recently been discovered in the Chedabucto Bay area of Nova Scotia. The paleogeographic distribution of Triassic rocks in Nova Scotia extends at least 85 mi. farther E. than previously recognized.--Auth.

3-1137. Johnson, Ross B., and Elmer H. Baltz. PROBABLE TRIASSIC ROCKS ALONG EASTERN FRONT OF SANGRE DE CRISTO MOUNTAINS, SOUTH-CENTRAL COLORADO: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1895-1902, map, sec., Dec. 1960, 13 refs.

Sedimentary rocks of Triassic age generally have been thought to be missing from outcrops in the Sangre de Cristo Mountains of Colorado where at most places the Entrada sandstone of Jurassic age rests unconformably on rocks that have been assigned to the Sangre de Cristo formation of Pennsylvanian and Permian age. Two units of probable Triassic age have been separated from the top of the Sangre de Cristo formation; one is here described and named the Johnson Gap formation. The other is correlated with the Lykins formation of central Colorado and in this report is referred to as the Lykins(?) formation.

The Johnson Gap formation crops out for 8 mi. or more N. of the Colorado-New Mexico boundary, and is correlated with a part of the Dockum group of Triassic age of northern New Mexico. The Lykins(?) formation crops out in the area of Huerfano Park and locally along the eastern front of the Sangre de Cristo Mountains as far S. as the North Fork of the Purgatoire River. Fossil wood found near the top of the unit has been determined as Triassic(?) in age.

The Johnson Gap formation and the Lykins(?) formation differ lithologically and probably are not correlative. The Johnson Gap consists mainly of gray silty conglomeratic limestone interbedded with gray and light red silty and siliceous limestone, red siliceous siltstone, greenish gray and brown plastic shale, and gray fine-grained quartzose sandstone. The Lykins(?) is made up of brownish red, purplish red, and buff sandstone, siltstone, and shale, and a few thin light gray limestone beds. It is probably older than the Johnson Gap formation in that the Lykins(?) formation seems to grade into the underlying Sangre de Cristo formation, whereas the Johnson Gap formation overlies the Sangre de Cristo unconformably.

The striking lithologic similarity of the rocks of the Lykins(?) formation along the eastern front of the Sangre de Cristo Mountains to those of the most southerly exposures of the Lykins formation 20 mi. ENE. of Cañon City, Colorado, suggests that the rocks once were probably continuous throughout S.-central Colorado, but were locally removed by erosion following a post-Triassic uplift in the general area of the Wet Mountains.--Auth.

3-1138. Jeletzky, J.A. UPPERMOST JURASSIC AND CRETACEOUS ROCKS, EAST FLANK OF RICHARDSON MOUNTAINS BETWEEN STONY CREEK AND LOWER DONNA RIVER, NORTHWEST TERRITORIES: Canada, Geol. Survey, Paper 59-14, 31 p., 2 maps (in pocket), scale 1:63,360, chart (in pocket), table, 1960, 18 refs.

Covers an area 5-12 mi. wide and 60 mi. long and supplements GeoScience Abstracts 1-853. Sequence as follows: 1) Marine shale-siltstone, 970-1,030 ft., Jurassic (?late Oxfordian to late Tithonian or Aquitonian), overlain by 230-240 ft. Lower Cretaceous (early Berriasian). 2) Sandstone, 500-540 ft., early Lower Cretaceous (late Berriasian-late Valanginian), lower part marine, upper apparently nonmarine. Units 1 and 2 replaced by 500-600 ft. of littoral glauconitic sandstones and conglomerates in southern part of area. 3) Coal-bearing sequence, 520 ft., early mid-Lower Cretaceous (Hauterivian) coal seams, 1-5 ft. in nonmarine lower member, upper member partly marine, only minor coaly rocks. This unit removed by erosion in southern part of area. 4) Marine shale-siltstone, 1,500-1,750 ft., mid-Upper Cretaceous (late Hauterivian-Barremian), transgressive on Units 1-3. Increases to 3,000 ft. in southern part of the area where shales are partly replaced by sandstones, etc. 5) Sandstone, 400-900 ft., mid-Lower Cretaceous (late Barremian to late Aptian), marine. 6) Shale-siltstone, 315-1,000 ft., Albian. 7) Shale, marine, up to 1,000 ft., Upper Cretaceous (Cenomanian-Coniacian and (?)younger), transgressive.

Structure is mainly due to post mid-Upper Cretaceous (?Early Tertiary) orogeny. Major faults are N.,- NE., - and NW.-trending and contrast with central Richardson Mountains where folds rather than faults are dominant. A peculiar breccia on the S. shore of Donna River containing gypsum, (?)anhydrite, and exotic rock fragments, appears to be a piercement or diapir structure.

The area has petroleum possibilities but there are no active indications at surface. Coal seams in Unit 3 are of potential commerical value.--P. Harker.

3-1139. Ower, J.R. THE EDMONTON FORMATION: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 11, p. 309-323, map, sec., table, Nov. 1960, 20 refs.

The writer discusses the Edmonton formation [Upper Cretaceous] of central Alberta from field sections on the Red Deer, North Saskatchewan, and Athabasca rivers, and from well logs in the intermediate area. It has a thickness of 1,100 to 1,700 ft., and the writer divides it into 5 members, the lowest 4 being Fox Hills-Pierre in age and the uppermost Lance. The continuity of the Kneehills tuff zone (Member D) throughout the area as a marker between Lance and Pre-Lance sediments is demonstrated.

The Bearpaw marine shale is replaced by Edmonton continental sediments to the N. The stratigraphic continuity of the Edmonton-Belly River contact as an extension of the Bearpaw-Belly River contact is maintained throughout the area.

The writer concludes there is no evidence of irregular differential erosion of the Edmonton formation before deposition of the Paskapoo formation. There may be an angular disconformity between the 2 formations but, if it exists, it probably results in a slow progressive truncation of the uppermost Edmonton beds beneath the Paskapoo sandstone in an easterly direction.--Auth.

3-1140. Curtis, Neville M., Jr. LIGNITE IN THE RED BRANCH MEMBER, WOODBINE FORMATION, OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 9, p. 240-244, map, Sept. 1960, 9 refs.

This is the first reported occurrence of the Red Branch member [Cretaceous] in Oklahoma. Lignite beds are less than 1 ft. thick and are associated with

black carbonaceous shales. Spore and pollen content is currently under study.--Auth.

3-1141. Purcell, Tom E. THE MESAVERDE FORMATION OF THE NORTH AND CENTRAL POWDER RIVER BASIN, WYOMING: Shale Shaker, v. 11, no. 4, p. 2-20, 7 maps, 4 secs., Dec. 1960, 26 refs.

The Mesaverde formation [Upper Cretaceous] is made up of an upper [Teapot member] and a lower (Parkman member) eastward-pointing tongue of sandstone and a middle (Pumpkin Buttes(?) member) westward-pointing tongue of shale. The upper limit of the formation (Lewis-Mesaverde contact) represents a westward transgression and is younger to the W. The lower limit of the formation (Mesaverde-Steele contact) represents an eastward regression and is younger to the E. The Pumpkin Buttes(?) member is the result of a transgression near the end of Parkman time and a regression near the beginning of Teapot time. This transgression and regression were of smaller scale than the transgression and regression marking the formation boundaries. The Teapot and Parkman members were deposited in the marine and nonmarine portions of a delta or deltas. The eastern portion of the Pumpkin Buttes(?) member is made up of marine deposits. The western portion of the Pumpkin Buttes(?) member is made up of marine and deltaic deposits.

Accumulations of oil in the Mesaverde formation are largely due to stratigraphic conditions. Prospects for future oil or gas production from the Mesaverde formation of the thesis area are favorable. The most reliable method of exploring the area for production would involve thorough regional stratigraphic studies coupled with detailed studies of existing fields. A thorough understanding of the geologic history of the area should allow projection of stratigraphic and/or productive trends into localities of little control.--C. E. Branham.

3-1142. Nagibina, M. S. UPPER CRETACEOUS VOLCANIC FORMATIONS OF THE UPPER AMUR REGION: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 35-45, 2 illus., map, sec., table, pub. 1960.

A description of the composition and position of the upper Amur area volcanics is given, for the first time. Emphasis is put on the clean-cut spatial relationship of extrusives with major faults along the boundaries of major structural elements and their close association with large dike bodies which represent the roots of these extrusives.--Auth.

3-1143. Wiseman, John D. H., and William R. Riedel. TERTIARY SEDIMENTS FROM THE FLOOR OF THE INDIAN OCEAN: Deep-Sea Research, v. 7, no. 3, p. 215-217, Dec. 1960, 8 refs.

In 1959, Tertiary microfossils were found in 2 samples collected at or near the sediment surface by early expeditions in the Indian Ocean. These samples are: 1) sounding No. 10 of H.M.S. Egeria, collected Oct. 22, 1887, from a depth of 2,582 fms. (4,722 m.) at 20°40'S. 85°29'E.; and 2) a sample collected by S.M.S. Planet from a depth of 2,310 fms. (4,220 m.) at 8°45'S. 64°52'E., in 1906-1907.

Implications of occurrences of Tertiary sediments at or near the surface of the sea floor are noted. In 1951, it was speculated that the exposure of Tertiary sediments to Quaternary agencies of erosion on the floor of the Pacific was to a considerable extent dependent on Tertiary and Quaternary tectonic movements. This view must be modified as a result of more recent findings. Where biogenous Tertiary sediments are covered by slowly accumulating nonfossiliferous Quaternary clays, the Quaternary cover may be only 1 or 2 m. thick. In such areas, no great tectonic movement is needed to expose at least late Tertiary material to agencies of erosion and transportion. This could easily be accomplished by a small slump or a localized current, in an area of relatively low topographic relief.--From auth., p. 215, 216.

3-1144. Plakhotnik, V. G. THE STRUCTURE AND AGE OF THE SOVGAVAN' FORMATION OF THE SIKHOTE-ALIN, NORTH OF THE KHUTSIN HARBOR MERIDIAN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 63-68, 6 illus., map, pub. 1960, 9 refs.

The Sovgavan formation (46°-49°N., 136°-140°E.) of the Sikhote-Alin mountains, Soviet Far East, is a fairly homogeneous sequence of finely porous basalt, locally coarsely porous and vesicular, and occasionally dense, mostly gray to dark gray, locally black. The described sections illustrate the periodic volcanism responsible for formation of the basalt sequence. Total lack of pyroclastic formations in the sequence, and lack of any evidence of volcanic centers, suggests the predominance of a fracture-type lava extrusion. Field data throughout the basalt plateaus suggest that lavas were poured down the valleys of rivers toward the Sea of Japan and Tatar straits and into tectonic depressions.

Spore-pollen analyses of alluvial deposits underlying the basalts, and analysis of geomorphic features of valleys cutting the plateaus, indicate an upper Quaternary age for the basalt. Some individual sheets may belong to older divisions of the Quaternary.--A. C. Sangree.

3-1145. Hamblin, William Kenneth. PALEOGEOGRAPHIC EVOLUTION OF THE LAKE SUPERIOR REGION FROM LATE KEWEENAWAN TO LATE CAMBRIAN TIME: Geol. Soc. America, Bull., v. 72, no. 1, p. 1-18, 9 maps, sec., 3 graphs, table, Jan. 1961, 15 refs.

A combined study of regional stratigraphy, petrology, and paleocurrents was made of the Freda sandstone, Jacobsville sandstone, Bayfield group, Dresbach formation, and Franconia formation. Data pertaining to the location and nature of the source of the sediments were obtained primarily from petrology and directional sedimentary structures. Environmental reconstructions were based on patterns of lithologic variations, kinds of sedimentary structures, and heavy minerals.

This information indicates that the Northern Michigan highland extended through northern Wisconsin and northern Michigan and acted as a source of sediment from late Keweenawan through Dresbachian time. The Freda formation accumulated in the Keweenawan basin, which was N. of the Northern Michigan highland approximately in the present site of Lake Superior but extended considerably farther to the SW. Deposition took place in a flood-plain and lacustrine environment. Prior to the deposition of the Jacobsville-Bayfield sediments, the Keweenawan sequence was deformed and eroded, but the Northern Michigan highland persisted as a positive area, and the shape and extent of the basin remained much the same. A lacustrine environment predominated in

the central part of the basin, but much of the Jacobsville sandstone and Bayfield group undoubtedly represents fan deposits which merged northward into sediments of an alluvial plain. During Dresbachian time the Northern Michigan highland remained as a positive area, but shallow seas invaded the Lake Superior region from the NW. and central Wisconsin from the S. Most of the Dresbach sediments accumulated in a beach environment, but in southern Wisconsin an offshore neritic environment predominated. Prior to Franconian time there was a widespread regression of the seas, and most of the region was subjected to subaerial erosion. By Franconian time the Northern Michigan highland was reduced to a surface of low relief, and the seas readvanced across the entire area from the SW. An appreciable amount of the Franconia sediments accumulated in an offshore environment.--Auth.

3-1146. McFarlan, Edward, Jr. RADIOCARBON DATING OF LATE QUATERNARY DEPOSITS, SOUTH LOUISIANA: Geol. Soc. America, Bull., v. 72, no. 1, p. 129-158, 9 figs. incl. 4 maps, chart, diags., profiles, Jan. 1961, 35 refs.

The late Quaternary deposits of southern and offshore Louisiana record a complete cycle of sea-level fluctuation which is associated with major changes in the volume of ice on the continents since the beginning of the last glacial stage. In order to date the major events of this cycle, 122 samples from both the surface and subsurface have been analyzed by the radiocarbon method.

A eustatic curve based on the age determinations of these samples supports previous estimates from geological data that the sea during the early part of the cycle fell to a position at least 450 ft. below its present level. The lowest sample on this curve, which was deposited when sea level stood at -440 ft., shows that this fall took place more than 35,000 years ago. The rise of the sea during the middle part of the cycle occurred in 2 successive stages. The first stage is marked by a rise from more than -440 to -250 ft., about 200 ft., before 35,000 years ago, followed by a long stillstand. This period of stillstand terminated about 18,500 years ago with the beginning of the second-stage rise which brought the sea to its present position about 5,000 years ago. Sea level during the last part of the cycle has remained unchanged to the present.

The eustatic curve implies that the ice sheets of the last major glacial stage not only reached their maximum extension but had begun to retreat before 35,000 years ago. Furthermore, it indicates that the final stage of retreat began about 18,500 years ago and ended about 5,000 years ago. This latter estimate corresponds closely to dates obtained from glaciated areas and deep-ocean sediments for the final stage of ice withdrawal. No general agreement exists between the eustatic data and other estimates on the age of the maximum glaciation and the beginning of ice retreat.--Auth.

3-1147. Broecker, Wallace S. RADIOCARBON DATING OF LATE QUATERNARY DEPOSITS, SOUTH LOUISIANA: A DISCUSSION: Geol. Soc. America, Bull., v. 72, no. 1, p. 159-162, table, Jan. 1961, 14 refs.

Despite the large amount of work done in the Mississippi alluvial valley adequate definition of the pre-11,000-year course of sea level is not yet possible. McFarlan's suggestions of a stillstand in level from >35,000 to 18,000 years ago followed by a uniform rise in level from 18,000 to 5,000 years ago do not seem justified on the basis of the data presented.--Auth. concl.

5. PALEONTOLOGY

See also: Geomorphology 3-1082, 3-1083; Structural Geology 3-1119; Stratigraphy 3-1127.

3-1148. Traverse, Alfred. STILL MORE ON CONVERSION OF MICROSCOPE COORDINATES: Micropaleontology, v. 6, no. 4, p. 424, Oct. 1960, 5 refs.

Discusses Tschudy's note on the possibility of constructing a mechanical device, a slide rule, for direct reading of the conversions from one microscope to another. Such a device might be useful where large numbers of readings from one microscope must be converted for use on another instrument.--From auth.

3-1149. Zenkevitch, L.A., and J.A. Birstein. ON THE PROBLEM OF THE ANTIQUITY OF THE DEEP-SEA FAUNA: Deep-Sea Research, v. 7, no. 1, p. 10-23, fig., table, Aug. 1960, 44 refs.

The colonization of the abyssal zone by animals has extended over a very long geological time. The recent deep-sea fauna contains species which immigrated into the abyssal zone at different periods.

It is impossible to agree with Bruun that owing to a sharp decrease of the temperature of bottom waters during the late Tertiary the ancient deep-water fauna died out and that the abyssal zone was repopulated by young Quaternary forms. Since the determinations of paleotemperatures on which this concept is based were obtained by using shallow-water rather than deep-water Foraminifera, such a conclusion seems questionable. It is further contradicted by the existence in the abyssal zone of many undoubtedly ancient elements (2 species of Neopilina, Spinula, Pogonophora, etc.) and by the absence of a true deep-water fauna in deep basins, which were formed during the Quaternary (Japan, Mediterranean, and Red seas).

The computations of Menzies and Imbrie, which led these authors to the concept of a relatively young deep-water fauna are likewise far from convincing. The groups selected for analysis are not characteristic of the deep-sea fauna; they include only about 11% of the species recorded from depths exceeding 3,000 m. The dominant groups of the deep-water fauna, rich both in number of species and in biomass, are not preserved in fossil condition and were not taken into account by Menzies and Imbrie.

An analysis of the systematic position and pattern of vertical distribution of many important groups of deep-sea animals permits us to distinguish among them ancient and young settlers of great depths. Approximate counts show that the percentage of primitive archaic forms in the abyssal fauna is far higher than in the fauna of the shelf, thus providing evidence of the greater antiquity of the abyssal fauna.--Auth.

3-1150. ANCIENT ROCK STUDY: New York Times, v. 110, no. 37,647, p. 109, col. 2, Feb. 19,

1961.

Measurement of the precise B content of rock is the basis of a new paleoecological research tool being developed at Dartmouth by R.C. Reynolds, Jr. Precambrian and Cambrian marine environments and their relation to the appearance of early fossil forms is a present object of study.--M. Russell.

3-1151. Frey, David G. THE ECOLOGICAL SIGNIFICANCE OF CLADOCERAN REMAINS IN LAKE SEDIMENTS: Ecology, v. 41, no. 4, p. 684-699, 2 pls., 7 tables, Oct. 1960, 58 refs.

Cladoceran remains from sediment samples from water depths between 15 and 40 ft. were studied for 5 lakes at Madison, Wisconsin. The morphology of species is noted and several forms are illustrated. The remains closely resemble, qualitatively and quantitatively, populations living in the lakes as recorded by an earlier worker.

In the 4 major lakes, population densities of cladoceran remains, mean standing plankton crops, and quantities of organic N in the water all have the same rank order. Thus population densities of cladoceran remains are at least rough indicators of past primary plankton production. Furthermore the relative abundances of Cladoceran forms appear to be closely related to the morphometry of the lakes: Daphnia decreases, Bosmina increases, and chydorids (other than the locally planktonic Chydorus sphaericus) increase with decreasing area and mean depth in the lakes. The increase in chiefly littoral chydorids may reflect a shift in importance from limnetic towards littoral production. Cladoceran remains promise to be of great significance for studies in paleolimnology.--J.W. Valentine.

3-1152. Emerson, William K., and Leo G. Hertlein. PLIOCENE AND PLEISTOCENE INVERTEBRATES FROM PUNTA ROSALIA, BAJA CALIFORNIA, MEXICO: Am. Mus. Nat. History, Am. Mus. Novitates, no. 2004, 8 p., 3 figs., May 1960, 12 refs.

The presence of metazoan invertebrates from previously unreported exposures of Pliocene and Pleistocene sediments are recorded from the vicinity of Punta Rosalia (28°40'N. 114°16'W.), a small headland on the southwestern coast of Baja California, Mexico. The Pleistocene fossils were collected from conglomeratic sands resting on the platform of a low terrace which fronts the present beach and extends inland for a short distance to abut against the base of a plateau. The Pliocene fossils were collected from exposures in a small arroyo cut into the coastal edge of the plateau.

A late Pleistocene age is assigned to the terrace assemblage of 17 species of marine invertebrates, mostly mollusks, largely on the basis of the totally modern composition of the faunule and the occurrence of the marine sediments on the platform of the lowest emergent terrace of the area. The Pliocene faunule is composed of 10 species of mollusks, mostly pectens and oysters, and 2 species of barnacles. The composition of this assemblage suggests that the sediments are comparable in age with Pliocene sediments known from Turtle Bay, Baja California, Mexico (27°41'N. 114°53'W.).--W.K. Emerson.

3-1153. Emerson, William K. PLEISTOCENE INVERTEBRATES FROM NEAR PUNTA SAN JOSÉ, BAJA CALIFORNIA, MEXICO: Am. Mus. Nat. History, Am. Mus. Novitates, no. 2002, 7 p., fig., March 1960, 22 refs.

Pleistocene metazoan invertebrates are reported for the first time from the vicinity of Punta San José, Baja California, Mexico (31°28'N.). The fossiliferous deposits are largely eroded off the bluffs along the present shore and occur only in exposures protected from erosion. The collected fauna comprises 26 species: 25 mollusks and 1 annelid worm. The assemblage appears to be a lateral continuation of the cool-water, open-coast fauna reported from southern California to Punta Baja, Baja California (29°57'N.) in deposits on the platform of the lowest emergent terrace along the present coast. Viewed in terms of the W. American metazoan chronology, the composition of this assemblage requires an age assignment to the late Pleistocene.--Auth.

3-1154. Branson, Carl C. CONOSTICHUS: Oklahoma Geology Notes, v. 20, no. 8, p. 195-207, 4 pls., Aug. 1960, 12 refs.

Conostichus, a genus long referred to the algae, is a scyphomedusid jellyfish. Specimens are sand casts of the pits in the mud bottom in which the animal lived. The genus occurs in all series of the Pennsylvanian system, principally on the margin of the platform. The generic name Duodecimedusa is a junior synonym of Conostichus.--Auth.

3-1155. Fay, Robert O. THE BLASTOID COLLECTION OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES: Oklahoma Geology Notes, v. 21, no. 1, p. 10-22, 4 pls., Jan. 1961.

The collection comprises 8 genera, represented by about 365 specimens: Cryptoblastus (9), Ellipticoblastus (2), Globoblastus (13), Metablastus (2), Nucleocrinus (8), Orophocrinus (3), Pentremites (300 plus), and Schizoblastus (1). There are no types in the collection, and it is reasonably certain that Thomas Say's types were probably in Peale's Philadelphia Museum, later destroyed by fires in 1851 and 1865. Various species are described and figured, notably Ellipticoblastus orbicularis, from the Mississippian of England.--Auth.

3-1156. Fay, Robert O. THE TYPE SPECIES OF GLOBOBLASTUS HAMBACH: Oklahoma Geology Notes, v. 20, no. 11, p. 292-299, 4 pls., Nov. 1960, 5 refs.

The genus Globoblastus Hambach differs significantly from Orbitremites Austin & Austin, and both genera are distinct and valid. Globoblastus has 2 hydrospire folds on each side of an ambulacrum, short deltoids overlapped by radials, and occurs in the Burlington limestone [Mississippian] of North America. Orbitremites has one hydrospire fold on each side of an ambulacrum, long deltoids which overlap the radials, and occurs in the Carboniferous limestone of England. A detailed morphological description of Globoblastus norwoodi is given, based upon characters of specimens in the collections of the University of Kansas and the University of Illinois. --Auth.

3-1157. Fay, Robert O. THE TYPE OF NUCLEOCRINUS CONRAD: Oklahoma Geology Notes, v. 20, no. 9, p. 236-239, 2 illus., Sept. 1960, 3 refs.

The holotype of blastoid Nucleocrinus elegans Conrad 1842, type species for the genus Nucleocrinus,

is on deposit at the American Museum of Natural History. It is illustrated photographically for the first time and is briefly described.--Auth.

3-1158. Fay, Robert O. THE TYPE SPECIES OF ORBITREMITES AUSTIN AND AUSTIN 1842, AND ELLIPTICOBLASTUS, A NEW MISSISSIPPIAN GENUS: Oklahoma Geology Notes, v. 20, no. 12, p. 315-317, 7 figs. Dec. 1960, 5 refs.

The genera Orbitremites and Ellipticoblastus are restricted to the Mississippian rocks of England. Each genus has 1 hydrospire fold on each side of an ambulacrum and 5 spiracles around the mouth, but the deltoids overlap the radials in Orbitremites and the reverse is true in Ellipticoblastus. Globoblastus occurs in the United States, has 5 spiracles, and 2 hydrospire folds on each side of an ambulacrum, and the radials overlap the deltoids.--Auth.

3-1159. Frederickson, Edward A., and D. E. Waddell. AN UNUSUAL CRINOID FROM THE PENNSYLVANIAN OF OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 7, p. 172-174, pl., July 1960, 3 refs.

A specimen of a crinoid from the Pumpkin Creek limestone, near Ardmore, appears to be a new species of Paradelocrinus, although it lacks the funnellike basal concavity typical of the genus. The base of the dorsal cup is essentially flat, if not slightly convex. The crown is extremely well preserved and, although slightly crushed, all plates are discernible. The arm plates are simple, and the arms are tapering and bear no pinnules.--D.E. Waddell.

3-1160. Strimple, Harrell L. NOTES ON TWO CHESTER CRINOIDS: Oklahoma Geology Notes, v. 21, no. 1, p. 23-25, illus., Jan. 1961, 4 refs.

A metatype of Mantikosocrinus castus, the second known specimen, reveals some additional details of the form of the species. The first dorsal cup of Bronaughocrinus figuratus known permits description of the arm-articulating facets. Specimens were collected in the Cookson Hills, SE. of Ft. Gibson, Oklahoma.--C.C. Branson.

3-1161. Fay, Robert O. THE "PORES" OF STEPHANOCRINUS CONRAD: Oklahoma Geology Notes, v. 20, no. 10, p. 256-259, illus., 7 figs., Oct. 1960, 2 refs.

Serial sections of a specimen of Stephanocrinus gemmiformis Hall show that external pores are absent on the coronal processes. Pores appear to be present only in weathered specimens, and these are coronal extensions of the coelomic cavity. Thus, on the basis of "pores," the group of echinoderms included in the order Coronata, including Stephanocrinus, should be classed as a separate order of the class Crinoidea.--Auth.

3-1162. Strimple, Harrell L. THE POSTERIOR INTERRADIUS OF CARBONIFEROUS INADUNATE CRINOIDS OF OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 10, p. 247-253, 3 figs., Oct. 1960, 13 refs.

In late Paleozoic inadunate crinoids the number of and arrangement of anal plates are significant in identification. Three significant developmental trends are: 1) tendency to exclude the right second anal plate from the cup and to resorb the radianal plate; 2) the radianal plate becomes the dominant anal plate, but tends to be resorbed; and 3) all anal plates are lost except the radianal.--C.C. Branson.

3-1163. Branson, Carl C. A RESTRICTED BIOFACIES: Oklahoma Geology Notes, v. 20, no. 10, p. 259-260, Oct. 1960, ref.

A thin shale bed above algal limestone contains abundant invertebrate fossils, specimens of brachiopod Desmoinesia muricatina constituting 80% of a recent collection. Eleven other species appeared in the collection and 7 other species known to occur in the unit were not found. The unusual biofacies occurs in the Perry Farm member of the Lenapah limestone [Pennsylvanian] at the type locality of the Lenapah.--Auth.

3-1164. Sohl, Norman F. ARCHEOGASTROPODA, MESOGASTROPODA, AND STRATIGRAPHY OF THE RIPLEY, OWL CREEK, AND PRAIRIE BLUFF FORMATIONS: U.S. Geol. Survey, Prof. Paper 331-A, p. 1-151, 11 figs. incl. 4 maps, 2 charts, 18 pls. incl. 2 maps (in pocket), table (in pocket), 1960, 161 refs.

The first of a proposed 2-part treatment of the Late Cretaceous (Maestrichtian) gastropod faunas of the Ripley, Owl Creek, and Prairie Bluff formations of southern Tennessee and northern Mississippi. In this part of the Mississippi embayment both the Ripley and the Owl Creek and Prairie Bluff formations present similar patterns of sedimentation. During the entire span of time represented by these formations, sand (clastic sediment) predominates in the northern areas and chalk (carbonate) predominates in the southern areas. At various times the demarcation line of the sedimentary provinces shifted back and forth, as exemplified by the southern shift during middle Ripley time owing to the great influx from the N. of the sands which formed the McNairy sand member. Thus, laterally, one finds a series of interfingerings of different lithologic types.

The Ripley formation is thickest in the northern areas of outcrop, where in the vicinity of the Tennessee-Mississippi state line it is close to 350 ft. thick. The formation thins southward until near the Alabama-Mississippi state line it is only about 60 ft. thick. In northern Mississippi the formation can be divided into 5 units, which are, from oldest to youngest, transitional clay, Coon Creek tongue, McNairy sand member, sand of the upper part of the Ripley, and the Keownville limestone member (new name).

The base of the Ripley is gradational downward to the Demopolis chalk through a dominantly clayey unit termed the transitional clay. In Tennessee and northernmost Mississippi, this clay unit lies entirely within the Exogyra cancellata zone, but S. of southern Tippah County the transitional clay lies in part above that zone. This clay, along with the rest of the formation, grades into sandy chalk in Noxubee County, Mississippi. Upward, the clay becomes increasingly sandy and grades into the highly fossiliferous sand units of the Coon Creek tongue. The Coon Creek varies in age along the outcrop belt. At the type locality on Coon Creek, Tennessee, the sand contains Exogyra cancellata Stephenson; but in Mississippi a few miles S. of the state line, the member lies entirely above that zone. The sand of the

Coon Creek tongue grades upward through thinner bedded lighter colored sand and clay beds into the varicolored crossbedded McNairy sand member. The McNairy represents a blanket deposit of shallow-water irregularly bedded sand that spread out from the head of the Mississippi embayment S. to Union County, Mississippi. Its maximum southward extent was probably reached in middle Ripley time. The McNairy sand member bears few fossil invertebrates. Locally, massive but lenticular clay units contain abundant plant material. Deep-water fossiliferous sand beds of the upper part of the Ripley formation overlie the McNairy in Mississippi and are in turn followed by a sequence of fossiliferous Sphenodiscus- and echinoid-bearing limestone strata of the Keownville member, which extend as far S. as Chickasaw County. In the southern counties (Pontotoc County to Kemper County), the McNairy sand member is absent, and the greater part of the Ripley cannot be divided. In Noxubee County, Mississippi, the whole formation grades into the chalk facies. The unconformity at the top of the Ripley varies locally in magnitude. In some places the Keownville limestone member appears to be entirely eroded off, and the overlying Prairie Bluff chalk rests on sand of the middle part of the Ripley.

The Owl Creek formation consists of dark fossiliferous sand 30-40 ft. thick. In Hardeman County, Tennessee, the formation is overlapped by the Midway group; but southward along the outcrop belt it can be traced until it interfingers with the Prairie Bluff chalk in Pontotoc County, Mississippi. The Prairie Bluff chalk reaches a maximum thickness of about 70 ft. and is recognizable from southernmost Tippah County, Mississippi, to Bullock County, Alabama, where it interfingers with the Providence sand of the Chattahoochee River region. The unconformity at the base of the overlying sand and limestone of the Midway group is marked almost everywhere by a zone of reworked Cretaceous fossils. The relations of these formations are graphically represented on a plate, which presents columnar sections spaced N.-S. along the outcrop belt in Mississippi. A separate section is devoted to the measured stratigraphic sections of the individual collecting localities.

The bulk of the report consists of the section on systematic paleontology. Short discussions on terminology, method of description, state of preservation, and method of collecting are followed by the systematic part. Forty-eight genera of Archeogastropoda and Mesogastropoda are diagnosed and discussed. Of the 48 genera recognized, 4 are new: Dircella, Lemniscolittorina, Tintorium, and Graciliala. In addition, 3 new subgenera are proposed: Calliomphalus (Planolateralus), Arrhoges (Latiala), and Mathilda (Echinimathilda). In all, 94 species and 3 varieties are named, and 33 additional descriptions are included of material too poorly represented or preserved to warrant attachment of a specific name. Twenty-one species and 2 varieties are described as new, and numerous reassignments are made.

Occurrences and abundance data are presented on a chart keyed geographically and stratigraphically.--Auth.

3-1165. Haas, Otto H. LOWER CRETACEOUS AMMONITES FROM COLOMBIA, SOUTH AMERICA: Am. Mus. Nat. History, Am. Mus. Novitates, no. 2005, 62 p., 147 figs., June 1960.

Although 48 forms of ammonites from the Cordillera Oriental, ranging in age from lower Berriasian to Barremian, are referred to 26 genera which belong to the following families: Ancyloceratidae, Ptychoceratidae, Haploceratidae, Perisphinctidae, Olcostephanidae, Berriasellidae, Desmoceratidae, Holcodiscidae, Pulchelliidae, Douvilleiceratidae. The genera represented by the greatest totals of specimens or otherwise important are Olcostephanus, Berriasella, Substeueroceras, Thurmanniceras, Favrella, Sarasinella, Acanthodiscus, Pseudoosterella, and Nicklesia. Many species are new but of these only the following have been named: Leptoceras ubalaense, Kossmatia viterboensis, Olcostephanus delicatecostatus, Berriasella colombiana, Substeueroceras mutabile, Thurmanniceras santarosanum, Favrella colombiana, Sarasinella hondana, Oosterella colombiana, Pseudoosterella ubalaensis, Subsayella boyacaensis, and Spitidiscus simitiensis.--Auth.

3-1166. Hecht, Max K. A NEW FROG FROM AN EOCENE OIL-WELL CORE IN NEVADA: Am. Mus. Nat. History, Am. Mus. Novitates, no. 2006, 14 p., 6 figs., June 1960.

A new genus of frog, Eorubeta, is described from the Eocene of Nevada and is placed in the family Leptodactylidae. Its relationships to the Australian and South American members of the family are discussed.--Auth.

3-1167. Schaeffer, Bobb. THE CRETACEOUS HOLOSTEAN FISH MACREPISTIUS: Am. Mus. Nat. History, Am. Mus. Novitates, no. 2011, 18 p., 9 figs., Aug. 1960.

Macrepistius arenatus Cope from the marine lower Cretaceous Glen Rose formation of Texas is a specialized caturid holostean with a deepened skull and a grinding or crushing dentition. Although the jaws have the proportions of a typical predaceous caturid, the strength of the bite was probably increased by enlarged adductor mandibulae muscles associated with the deepened skull and expanded palate. The inclusion of Macrepistius in the Caturidae implies a broader adaptive radiation within this family than has been previously demonstrated.--Auth.

3-1168. Eaton, Theodore H., Jr. A NEW ARMORED DINOSAUR FROM THE CRETACEOUS OF KANSAS: Kansas, Univ., Paleont. Contr. [no. 22], Vertebrata, Art. 8, p. 1-24, 21 figs. 2 tables, Nov. 1960, 10 refs.

Silvisaurus condrayi, n.g. and n.sp., ankylosaurian dinosaur of the family Nodosauridae is described from the Terra Cotta clay member of the Dakota formation, Lower Cretaceous, Sec. 8, T. 10 S., R. 1 W., Ottawa County, Kansas. The genus is considered as probably ancestral to Edmontonia and it is probably the oldest North American ankylosaur known.--C.C. Black.

3-1169. Vyushkov, B.P., and A.I. Emelyanova. FIRST DISCOVERY OF FOSSIL REPTILES IN THE TUNGUSSKA BASIN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 87-88, pub. 1960.

The fossilized bones of a large reptile, order Dicynodontia, were found between the Permian and Triassic layers in the lower part of the Korvunchana river of the Tunguska basin.--LC.

3-1170. Turnbull, William D., and Charles A. Reed. ARCTORYCTES AND SOME OTHER CHADRONIAN VERTEBRATE MICROFOSSILS FROM NEBRASKA: Chicago, Nat. Hist. Mus., Fieldiana: Geology, v. 14, no. 3, p. 41-57, 6 figs., Dec. 1960, 15 refs.

A description of small bones of vertebrates from the Chadronian (lower Oligocene) of Nebraska. The collection was made from ant hills. Lizard, rodent, and edentate limb bones and several problematical foot bones are described. The range of Arctoryctes is extended down into the Chadronian. The problematical foot bones of fossorial animals are described and tentatively assigned to Arctoryctes and Cyrtoryctes (Edentata).--E.C. Olson.

3-1171. Wilson, Robert W. EARLY MIOCENE RODENTS AND INSECTIVORES FROM NORTHEASTERN COLORADO: Kansas, Univ., Paleont. Contr. [no. 22], Vertebrata, Art. 7, p. 1-92, 131 figs., Nov. 1960, approx. 150 refs.

Twelve species of Insectivora, 2 species of Lagomorpha, and 14 species of Rodentia are described from Quarry A in the Pawnee Creek formation, Sec. 27, T. 11 N., R. 53 W., Logan County, Colorado. The fauna is of late early Miocene age. One new genus and species, Mydecodon martini, talpid, is described along with 5 new species of insectivores and 4 new species of rodents. Two genera of rodents, Plesiosminthus and Pseudotheridomys, and 2 genera of insectivores, Heterosorex and Plesiosorex, previously known only from Eurasia, are recorded. The fauna is considered to represent a riparian-fluvial association. A discussion of the correlation of the European and North American Miocene sequences is presented. The Aquitanian is equated to the Harrisonian and early Marslandian, the Burdigalian to the late Marslandian and early Sheepcreekian, and the Vindobonian to the late Sheepcreekian, Mascallian, and Barstovian. The Quarry A fauna is of late Marslandian age and correlated with the Burdigalian.--C.C. Black.

3-1172. ASIAN FOSSIL MOLE REPORTED BY SOVIET: New York Times, v. 110, no. 37,633, p. 60, col. 5, Feb. 5, 1961.

The discovery of Miocene remains of a starnosed mole, genus Condilura, near Pavlodar, Soviet Central Asia, is additional evidence of a Tertiary land bridge between Alaska and Siberia. Condilura is common in the eastern United States and Canada but extinct in the Soviet Union.--M. Russell.

3-1173. Simons, Elwyn L. AN ANTHROPOID FRONTAL BONE FROM THE FAYUM OLIGOCENE OF EGYPT: THE OLDEST SKULL FRAGMENT OF A HIGHER PRIMATE: Am. Mus. Nat. History, Am. Mus. Novitates, no. 1976, 16 p., 4 figs., 2 tables, Nov. 1959, 14 refs.

An almost complete primate frontal bone, discovered in the upper part of the Fluvio-marine formation, Fayum, Egypt, is the oldest known anthropoid skull fragment. Anthropoid status is indicated by complete post-orbital closure of the orbital cavity.

This frontal, approximately 1 1/2 in. in diameter, demonstrates the existence of an early Oligocene anthropoid and illustrates some Oligocene primate skull characteristics. The primate has a vertically deepened fore brain and a foreshortened muzzle. This frontal is too small for Propliopithecus, but Apidium and Parapithecus are comparable in estimated size. Apidium has been collected in the upper part of the Fluvio-marine formation, and its dentition is somewhat more anthropoid than the dentition of Parapithecus, but a taxonomic reference cannot be made.

The characteristics of this fossil increase the likelihood that Apidium and Parapithecus are primates rather than protungulates.--H. A. Semken, Jr.

3-1174. Simons, Elwyn L. THE PALEOCENE PANTODONTA: Am. Philos. Soc., Trans., new ser., v. 50, pt. 6, 99 p., 9 figs., 18 pls., tables, July 1960, 88 refs.

A taxonomic review of the Paleocene Pantodonta is followed by a systematic revision which establishes the 2 superfamilies Coryphodontoidea and Pantolambdoidea. The following new genera and new species are introduced: Caenolambda jepseni n. sp.; Ignatiolambda barnesi n. g. and n. sp.; Titanoides majus n. sp.; and T. simpsoni n. sp. The skeletal anatomy of the various pantodonts are described in detail. The description of geologic and geographic occurrence shows the stratigraphic distribution of the 4 families to be as follows: Coryphodontidae - Wasatchian and Clarkfordian; Barylambdidae - Tiffanian; Titanoideidae - Tiffanian and Torrejonian; Pantolambdidae - Tiffanian and Torrejonian. The final section considers the relation of the Pantodonta to the other orders of mammals.--M. Russell.

3-1175. THEORY DISPUTED ON ROCK PAINTINGS: New York Times, v. 110, no. 37,633, p. 30, col. 3-5, illus., Feb. 5, 1961.

The extinct horse Equus rectidens is represented in cave paintings near Lake Nahuel Huapi, southern Argentine Andes. The paintings antedate the Spanish explorers, and are the first example of human paintings in the Western Hemisphere to portray now-extinct animals.--M. Russell.

3-1176. Martin, Paul S., and others. RAMPART CAVE COPROLITE AND ECOLOGY OF THE SHASTA GROUND SLOTH: Am. Jour. Sci., v. 259, no. 2, p. 102-127, 8 figs. incl. illus., map, charts, graphs, 2 tables, Feb. 1961, 43 refs.

The shasta ground sloth Nothrotherium shastense inhabited Rampart Cave in the Grand Canyon of the Colorado River, Arizona, for at least 25,000 years. During this interval occupation was probably discontinuous; radiocarbon dates of the dung from the surface of the cave are on the order of 10,000 years, from the 18-in. level 12,000 years, and from the 54-in. level older than 35,000 years. Dung samples collected at 6-in. intervals to a depth of 60 in. proved rich in well-preserved pollen. Within each level there is great variation in pollen content. In part this reflects seasonal change in flowering time of various plants growing adjacent to the cave. An increase in Artemisia, Pinus, Betula, Cupressaceae, and other montane trees and shrubs reveals that levels 18 through 48 represent a time of cooler or wetter climate with upper Sonoran vegetation displaced downward 2,000 to 4,000 ft.

These samples were analyzed spectrographically for trace element content. On theoretical grounds the abundance of Mn proves a promising index of climatic change; when compared with the pollen evidence, there is a reasonably good fit between high Mn values and periods of greater moisture. These

correspond to the Wisconsin glacial age.

Co is very rare and Cu is abundant in dung from all levels. There is no indication that a change in abundance of these triggered ground sloth extinction, as claimed by Salmi.

Nothrotherium excelled as a browser in the arid SW. Some of its preferred food plants, as creosote bush, yucca, snakeweed, and cactus, are not harvested systematically by existing large desert herbivores. The ecological niche of Nothrotherium remains unfilled. Its extinction defies an obvious environmental explanation either in terms of trace element deficiency, competition, or climatic change. The cause of extinction must lie elsewhere.--Auth.

3-1177. Fagan, Sylvia Robinson. OSTEOLOGY OF MYLAGAULUS LAEVIS, A FOSSORIAL RODENT FROM THE UPPER MIOCENE OF COLORADO: Kansas, Univ., Paleont. Cont. [no. 22], Vertebrata, Art. 9, p. 1-32, 32 figs., pl., 9 tables, Nov. 1960, 21 refs.

A detailed comparison of a skeleton of Mylagaulus laevis, mylagaulid rodent, from the late Barstovian of Logan County, Colorado, with that of the living Aplodontia rufa, aplodontid rodent, is given. It is concluded that certain characters are due to a similar fossorial habit while others are a result of phyletic relationship. Mylagaulus is shown to be more highly specialized in its fossorial adaptations than Aplodontia but less so than the geologically younger Epigaulus.--C.C. Black.

3-1178. Hiltermann, Heinrich. ANNOTATED BIBLIOGRAPHY OF MICROPALEONTOLOGY IN GERMANY FOR 1959: Micropaleontology, v. 6, no. 4, p. 425-432, Oct. 1960.

One hundred and nine papers on all aspects of micropaleontology are listed alphabetically by author and briefly reviewed.--Auth.

3-1179. Pożaryska, Krystyna. ANNOTATED BIBLIOGRAPHY OF MICROPALEONTOLOGY IN POLAND: Micropaleontology, v. 7, no. 1, p. 115-118, Jan. 1961.

Contains 36 papers concerned with micropaleontology and microstratigraphy or which mention microscopic fossils. In addition to Foraminifera, this bibliography covers spores and pollen, ostracodes, and other animal microfossils. The papers are listed alphabetically by author and briefly reviewed.--From auth.

3-1180. Hulme, S.G. A MECHANIZED METHOD OF BREAKING DOWN AND WASHING FORAMINIFERAL ROCK SAMPLES: Micropaleontology, v. 7, no. 1, p. 107-113, 4 illus., 5 diags., Jan. 1961.

A method and apparatus for the processing of foraminiferal samples is described and illustrated. Although speed of sample processing has been one object of mechanization, a balance of the 3 following factors has been maintained: quality of the finished residue, quantity of the sample processed, and reduction of contamination to a minimum. The dimensions of the apparatus given in this paper are those most suitable for handling a sample of up to approximately 36 cu. in. By reducing these dimensions a greater number of smaller samples can be handled. The apparatus is set up in pairs, which permits quicker sample processing.--From auth.

3-1181. Pessagno, Emile A., Jr. THIN-SECTIONING AND PHOTOGRAPHING SMALLER FORAMINIFERA: Micropaleontology, v. 6, no. 4, p. 419-423, 3 diags., 2 pls., Oct. 1960, 6 refs.

The transparent-slide method of thin-sectioning and a method of making photomicrographs are discussed and illustrated.--Auth.

3-1182. Joysey, K.A. NOTE ON THE BRADY COLLECTION OF FORAMINIFERA: Micropaleontology, v. 6, no. 4, p. 416, Oct. 1960, 2 refs.

The purpose of this note is to publicize the fact that specimens in the H.B. Brady Collection, which may have been described as missing during the period 1939-1959, may now be available at the British Museum. It is hoped that this statement will help to prevent future taxonomic confusion.--Auth.

3-1183. Adams, C.G. A NOTE ON TWO IMPORTANT COLLECTIONS OF FORAMINIFERA IN THE BRITISH MUSEUM (NATURAL HISTORY): Micropaleontology, v. 6, no. 4, p. 417-418, Oct. 1960, 3 refs.

Briefly discusses 2 well-known collections of Foraminifera in the British Museum which are often thought to be deposited either partly or entirely elsewhere. Part of the Challenger collection of Recent Foraminifera was transferred from the Zoological Museum of the University of Cambridge in 1939; the move was completed in 1959. The entire collection is now at the Museum except for a few slides which cannot be found. The Alfred Issler collection of Jurassic Foraminifera has been at the Museum since 1910 when the Museum bought it from Issler and had it moved from the Geologisches Institut, Tübingen, Germany. This collection consists of 182 slides, all of them strew preparations in Canada balsam.--L.M. Dane.

3-1184. Bandy, Orville L., and Robert E. Arnal. CONCEPTS OF FORAMINIFERAL PALEOECOLOGY: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1921-1932, 14 figs. incl. 7 maps, graphs, profiles, Dec. 1960, 20 refs.

Studies of modern foraminiferal ecology have provided at least 5 distinct criteria for the reconstruction of marine paleoenvironments: 1) both the number of species and specimen abundance increase away from shore and with increasing depth of water to maximum values on the outer shelf and in the upper and middle bathyal zone; 2) diverse porcelaneous species are abundant in shoal nearshore marine environments; 3) arenaceous Foraminifera with simple interiors may be abundant in shallow waters whereas more complex types with labyrinthic interiors are more characteristic of bathyal depths; 4) deposition of planktonic species occurs most abundantly on the outer shelf and in the upper bathyal zone, with even greater abundances in deeper waters under the right conditions; and 5) similar environmental adaptations of modern species and fossil homeomorphs (and isomorphs) may be assumed, especially for groups of species.

Faunal contamination or mixed faunas must be recognized as an ever-present deterrent to valid stratigraphic and paleoecologic analyses. One important type of contamination is the displacement of

shoal faunas into deeper water; however, the displacement problem is minimized by selecting the deepest bathymetric indicator species in each sample. Another type of mixed fauna is produced by the reworking of faunas from older strata into younger sediments. This type of contamination usually is recognizable by differences in preservation or incongruous mixtures of index species of different ages or both.

To test the value of foraminiferal ecology to the finding of oil deposits, a detailed study was made of the biofacies of the middle Tertiary of the San Joaquin Valley, California. The analyses of more than 5,000 samples (cores) made it possible to construct a series of paleobathymetric maps showing the gradual evolution of the San Joaquin basin. Examples of this study are presented to illustrate the methods of applied paleoecology and their implications.--Auth.

3-1185. Shifflett, Elaine. LIVING, DEAD, AND TOTAL FORAMINIFERAL FAUNAS, HEALD BANK, GULF OF MEXICO: Micropaleontology, v. 7, no. 1, p. 45-54, map, 2 graphs, 4 tables, Jan. 1961, 9 refs.

Recent living, dead, and total foraminiferal populations in sediment samples collected by aqualung divers in the vicinity of Heald Bank, NW. Gulf of Mexico were studied. Fifty living species were identified; living specimens composed 35% of the total fauna. Comparisons of living, dead, and total populations permit valid ecological conclusions and suggest geological considerations on changing conditions and transportation of tests. Faunal variations within short lateral distances are appreciable. --Auth.

3-1186. Bé, Allan W.H. ECOLOGY OF RECENT PLANKTONIC FORAMINIFERA: PART 2 - BATHYMETRIC AND SEASONAL DISTRIBUTIONS IN THE SARGASSO SEA OFF BERMUDA: Micropaleontology, v. 6, no. 4, p. 373-392, 19 figs. incl. 2 maps, profiles, graphs, 6 tables, Oct. 1960, 33 refs.

Studies of the bathymetric distribution of planktonic Foraminifera indicate that they are most abundant in the euphotic zone of the oceanic waters around Bermuda. Seasonal fluctuations in the relative and absolute abundances of 15 species have been observed from 106 plankton samples, showing a regular succession in the foraminiferal populations. Globorotalia hirsuta, G. truncatulinoides, Globigerina inflata, and G. bulloides were most abundant in winter and spring, when temperatures within the euphotic zone ranged between 18° and 23°C. and salinities varied between 34.40‰ and 36.60‰. Globorotalia menardii, Globigerinoides sacculifer, and G. conglobatus reached their maximum concentrations in summer and fall, when temperatures ranged between 23° and 27°C. and salinities between 36.10‰ and36.40‰. The oceanographic and paleoecologic implications of these observations are discussed for the northern Sargasso Sea.--Auth.

3-1187. Bandy, Orville L. DISTRIBUTION OF FORAMINIFERA, RADIOLARIA AND DIATOMS IN SEDIMENTS OF THE GULF OF CALIFORNIA: Micropaleontology, v. 7, no. 1, p. 1-26, 14 figs. incl. 9 maps, 5 pls., 3 tables, Jan. 1961, 40 refs.

A study was made of the Foraminifera, diatoms, and Radiolaria in bottom samples from the Gulf of California. Seventeen separate foraminiferal faunas are recognized, spanning the range from paralic facies to a depth of more than 3,000 m. Planktonic and benthonic Foraminifera are more abundant than diatoms and Radiolaria in sediments of the continental shelf and in the upper bathyal zone; Radiolaria and diatoms are most abundant in sediments of the basin bottoms; Radiolaria are relatively most abundant in the deepest basins at the S. end of the Gulf. Sill depths appear to control the dominant distribution patterns of the basin assemblages.--Auth.

3-1188. Hofker, Jan. THE GENS GLOBIGERINA CRETACEA IN NORTHWESTERN EUROPE: Micropaleontology, v. 7, no. 1, p. 95-100, 2 diags., pl., Jan. 1961, 14 refs.

Globigerina cretacea d'Orbigny, described by d'Orbigny in 1840 as the only trochoid Globigerina from the Craie blanche of the Paris basin, began its development in the Aptian-Albian with the form Praeglobotruncana infracretacea (Glaessner); it gradually changed (by enlargement and by change in apertural conditions) into Praeglobotruncana sp. cf. P. gautierensis (Bronnimann) of Bolli, and occurs in the Cenomanian as P. crassa Bolli. Due to the enlargement of the later chambers, the apertural conditions changed gradually, and the developmental stage of typical Globigerina cretacea d'Orbigny was reached, beginning in the Turonian. At the end of the Maestrichtian, aberrant forms appeared, of which Rugoglobigerina rugosa (Plummer) is the most common. Since a single biological unit ("gens") passes through 3 different "genera," at least 2 of them (Praeglobotruncana and Rugoglobigerina) must be regarded as artificial. This can also be said of the different "species." The gradual change is illustrated by figures of the different stages, as well as by statistical diagrams.--Auth.

3-1189. Echols, Dorothy Jung, and Katherine M. M. Schaeffer. MICROFORAMINIFERA OF THE MARIANNA LIMESTONE (OLIGOCENE), FROM LITTLE STAVE CREEK, ALABAMA: Micropaleontology, v. 6, no. 4, p. 399-415, 2 pls., table, Oct. 1960, 112 refs.

A study based on 2 samples of the Marianna limestone from Little Stave Creek, Clarke County. One sample is from the Limestone member and the other from the Mint Spring member. The entire foraminiferal population was studied in order to establish the relationship of the microforaminifera to the other Foraminifera present in each sample. Measurements made on series of Foraminifera ranging in size from 60 to 800 microns indicate the lack of a natural size boundary for the microforaminifera group. Identifications of microforaminifera, where possible, were based on comparisons with Foraminifera of larger size. Most microforaminifera are believed to be megalospheric forms. Some microforaminifera are not sufficiently differentiated in coiling or distinctive in test character, to permit identification with established genera or species. The lithology and microfossil assemblage of the 2 samples suggest deposition of the Marianna limestone in clear, calm, lower-neritic waters.--Auth.

3-1190. Jenkins, D. Graham. PLANKTONIC FORAMINIFERA FROM THE LAKES ENTRANCE OIL SHAFT, VICTORIA, AUSTRALIA: Micropaleontology, v. 6, no. 4, p. 345-371, map, 2 charts, 7 graphs, 5 pls., Oct. 1960, 31 refs.

Some 48 species and subspecies of planktonic Foraminifera, 8 of which are new, have been identified and their stratigraphic ranges established in a closely sampled sequence of Miocene rocks from SE. Australia. Zoning based on the ranges of these Foraminifera is discussed, and the use of initial appearances of evolving species is strongly advocated. Intercontinental correlation of the foraminiferal zones is feasible, and comparison with the Caribbean is reasonably close.--Auth.

3-1191. Kornicker, Louis S. ECOLOGY AND TAXONOMY OF RECENT BAIRDIINAE (OSTRACODA): Micropaleontology, v. 7, no. 1, p. 55-70, 10 figs. incl. maps, diags., graphs, pl., 3 tables, Jan. 1961, 32 refs.

Thirteen species belonging to the ostracode genus Bairdia are divided into 4 groups based on differences and similarities in the morphology of the male copulatory organ. The effect of temperature, salinity, and substrate on the distribution of Bairdia is discussed. Four new species of Bairdia and one new species of Bairdoppilata collected in the Bahamas are described. The carapaces of females have smaller length-height ratios than those of males.--Auth.

3-1192. Kornicker, Louis S., and Charles D. Wise. SOME ENVIRONMENTAL BOUNDARIES OF A MARINE OSTRACODE: Micropaleontology, v. 6, no. 4, p. 393-398, 8 figs. incl. map, graphs, Oct. 1960, 13 refs.

Individuals of the marine ostracode Hemicythere conradi Howe and McGuirt were acclimated in the laboratory at a salinity of 30 parts per thousand and water temperatures of 20-26°C. They were able to survive salinities from 6 to 65 parts per thousand and water temperatures from 6° to 36°C. Individuals of this species also exhibited a positive response to light and preferred silty sand to coarser oölitic sand when given free choice in laboratory experiments. The results are discussed in relation to the distribution of the species in the field.--Auth.

3-1193. Harris, Reginald W. REVIEW OF SYSTEMATICS AND RECENT RESEARCH OF PRIMITIOPSID OSTRACODA: Oklahoma Geology Notes, v. 20, no. 7, p. 176-182, illus., July 1960, 14 refs.

A chronological resumé reveals the ostracode Family Primitiopsidae to be subdivided into 4 subfamilies that contain 9 genera. Six species of the genus Anisocyamus of the Ordovician Subfamily Anisocyaminae are illustrated in stratigraphic position in Oklahoma Ordovician Simpson formations (McLish, Tulip Creek, and Bromide). The Subfamily Primitiopsinae includes 3 Silurian genera. The Devonian Subfamilies Sulcicuneinae and Polenovulinae include 1 and 2 of genera, respectively.--Auth.

3-1194. Harris, Reginald W. AN INDEX OSTRACODE FROM THE ARBUCKLE LIMESTONE, OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 9, p. 211-216, fig., pl., Sept. 1960, 14 refs.

Ceratoleperditia n. gen. is established as a new ceratopsid ostracode genus of the Family Leperditiidae. The genotype, C. arbucklensis n. sp., is a commonly occurring index fossil of the uppermost Arbuckle (West Spring Creek) limestone (Ordovician) of the Arbuckle Mountains. The species is relatively large (6 mm. or more in length), with leperditian retral swing, muscle scar chevron, and distinct eye tubercle. Lateral views and end profiles illustrate a characteristic subcentral spine that serves for ready identification of exposed lateral surface or sectional profile in rock fragment. In convexity, eye tubercle, and pending spine the new species closely resembles C. (Isochilina) kentuckyensis Ulrich, from the Lowville "Birdseye" limestone of Kentucky, although it lacks the peripheral flange ascribed to the Kentucky species.--Auth.

3-1195. Wilson, L.R. A PERMIAN HYSTRICHOSPHAERID FROM OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 7, p. 170, illus., July 1960.

No Permian hystrichosphaerids have been previously reported in print. A new species of Hystrichosphaeridium, recovered from the Flowerpot shale, Greer County, is illustrated and described but not named.--Auth.

3-1196. Das, Pratima. RECENT MICROSCOPIC FLORA FROM THE BENGAL DELTA, INDIA: Micropaleontology, v. 7, no. 1, p. 87-94, map, 2 pls., Jan. 1961, 4 refs.

Diatoms and associated acid-insoluble microscopic forms from the Recent sediments of the freshwater tanks and the mangrove swamps of the Bengal delta are described and illustrated.--Auth.

3-1197. Becker, Herman F. OLIGOCENE PLANTS FROM THE UPPER RUBY RIVER BASIN, SOUTHWESTERN MONTANA: Geol. Soc. America, Mem. 82, 127 p., 3 maps, sec., 32 pls., 8 tables, 1961, 97 refs.

A flora from Tertiary fossiliferous shales of the upper part of the Ruby basin in southwestern Montana is described. The intermontane lacustrine deposits consist of 2 phases with distinct floral assemblages. The composite flora comprises aquatic, riparian temperate deciduous- and coniferous-forest, xeric-woodland, and desert-scrub associations. The flora consists of 37 families, 61 genera, and 82 identifiable species of which 25 are heretofore undescribed. Three additional new species are described among the Incertae sedis. Approximately 12% of the species are gymnosperms, and 85% are angiosperms. Arcto-Tertiary and Madro-Tertiary elements are equally represented. Comparison with the Bridge Creek and Green River floras discloses a 13% and 4.5% respective overlap. Significantly, a 40% specific identity exists between the Ruby and Florissant floras. Nearly identical floristic units suggest that the Ruby and Florissant floral assemblages were part of a single botanical province.

The fossiliferous shales of the Ruby area are late Oligocene and nearly contemporaneous with the Bridge Creek shales but younger than those of the Florissant area. The Recent flora is chiefly xeric-semidesert, xeric-coniferous, Hudsonian-deciduous, and Hudsonian-coniferous.--Auth.

3-1198. Wilson, L.R. DEVELOPMENT OF PALEOBOTANY IN OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 9, p. 217-223, Sept. 1960, 88 refs.

A search of the literature has revealed that the earliest paleobotanical observation was by Jules Marcou on July 19, 1853, during the Mississippi River to Pacific Ocean Survey of 1853-1854. In the succeeding 107 years approximately 85 publications

have appeared in which Oklahoma's fossil plants are reported or paleobotanical techniques have been described by Oklahomans. Almost one-third of the publications have appeared in the last 3 years.--Auth.

3-1199. Gillespie, W.H., and I.S. Latimer, Jr. A GUIDE TO THE COMMON FOSSIL PLANTS OF WEST VIRGINIA: West Virginia Geol. & Econ. Survey, Educ. Ser., 59 p., 15 figs., 23 pls., 1960, 8 refs.

Brief descriptions and photographic illustrations of 35 of the more common fossil plant genera of West Virginia are presented, including fossil leaf compressions, stems, seeds, and cones. Notes on the number of species and the geologic horizons are also included. A key for the identification of fossil leaf genera is provided.

Topics covered include how to collect, process, and study fossil plants; plant classification; the formation of coal; fossilization processes; and geologic time.--Auth.

3-1200. Kremp, G.O.W., and others. CATALOG OF FOSSIL SPORES AND POLLEN. VOLUME 10. JURASSIC AND CRETACEOUS SPORES AND POLLEN: 180 p., illus., University Park, Pennsylvania, Pennsylvania State University, College of Mineral Industries, Dept. of Geology, Palynological Laboratories, 1960, refs.

Vol. 10 contains 173 descriptions of specific or subspecific rank. These descriptions were reproduced from the works of N.A. Bolkhovitina, 1956, Atlas of Spores and Pollen from Jurassic and Lower Cretaceous Deposits of the Vilyuy Depression, and Vishnu-Mittre, 1955, Sporojuglandoidites Jurassicus gen. et sp. nov. A Sporomorph from the Jurassic of the Rajmahal Hills, Bihar.

3-1201. Kremp, G.O.W., and others. CATALOG OF FOSSIL SPORES AND POLLEN. VOLUME 12. DEVONIAN SPORES: 154 p., illus., University Park, Pennsylvania, Pennsylvania State University, College of Mineral Industries, Dept. of Geology, Palynological Laboratories, 1960, refs.

Vol. 11 (GeoScience Abstracts 2-2030) presented descriptions of 150 taxa from Naumova's 1953 publication on the Spore-Pollen Complexes of the Upper Devonian of the Russian Platform and Their Significance for Stratigraphy. The remaining 147 taxa are described in this volume. Taxa have been arranged alphabetically in the complementary volumes. Vol. 12 contains the following genera: Hymenozonotriletes (in part), Leiotriletes, Lophotriletes, Lophozonotriletes, Perisaccus, Retusotriletes, Stenozonotriletes, and Trachytriletes. Although not implied in the title of the Soviet publication, a number of taxa attributed to the Middle Devonian are also included.--From pref.

3-1202. Gray, Henry H., and G.K. Guennel. ELEMENTARY STATISTICS APPLIED TO PALYNOLOGIC INDENTIFICATION [SIC] OF COAL BEDS: Micropaleontology, v. 7, no. 1, p. 101-106, diag., 6 graphs, 6 tables, Jan. 1961, 6 refs.

Relative abundance of miospore types is a powerful criterion for stratigraphic identification of coal beds. Precision of this technique is improved by application of simple statistical tests, such as Chi-square, which allow objective evaluation of the data. To be conducive to statistical analysis, quantitative collection and treatment of samples is essential. In order to characterize spore populations with adequate precision, many spores must be counted and grouped into few types.--Auth.

3-1203. Hughes, N.F., and G. Playford. PALYNOLOGICAL RECONNAISSANCE OF THE LOWER CARBONIFEROUS OF SPITSBERGEN: Micropaleontology, v. 7, no. 1, p. 27-44, 2 diags., 4 pls., 3 tables, Jan. 1961, 29 refs.

Microspores are described from 3 representative rock samples from the Billefjorden sandstones of the lower Carboniferous of central Vestspitsbergen. The age of this series is considered to range from Tournaisian to at least Visean and perhaps Namurian. One new genus, Velosporites, and 13 new species are erected. Several species are shown to resemble previously described Russian, Canadian, and Scottish types.--Auth.

3-1204. Dettmann, Mary E. LOWER MESOZOIC MEGASPORES FROM TASMANIA AND SOUTH AUSTRALIA: Micropaleontology, v. 7, no. 1, p. 71-86, 2 figs., 4 pls., Jan. 1961, 47 refs.

Eight megaspore species from Tasmanian and South Australian lower Mesozoic sediments are recorded; 6 of these are new types. Megaspores referable to Nathorstisporites hopliticus Jung, which includes those of Lycostrobus scotti Nathorst, are recorded for the first time from the Southern Hemisphere. Two new species of Nathorstisporites and closely associated microspores are described. A new genus, Banksisporites, is instituted to include the megaspores previously referred to Trileites pinguis (Harris) Potonié and Duosporites tenuis (Dijkstra) Piérart. A Rhaetic-Liassic and a Rhaetic age are indicated for the Leigh Creek Coal Measures, South Australia, and the New Town Coal Measures, Tasmania, respectively.--Auth.

6. GEOPHYSICS

See also: Geomorphology 3-1102.

3-1205. Adams, Leason H., ed. UNITED STATES NATIONAL REPORT, 1957-1960. TWELFTH GENERAL ASSEMBLY, INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS: Am. Geophys. Union, Trans., v. 41, no. 2, p. 127-318, illus., map, diags., graphs, tables, June 1960, 1,697 refs.

The triennial report to the Twelfth General Assembly of the International Union of Geodesy and Geophysics, Helsinki, July 25-Aug. 6, 1960, prepared by the American Geophysical Union as the U.S. National Committee of the I.U.G.G., is a comprehensive report of progress in geophysics in the United States during 1957-1959. A total of 67 brief articles, many with bibliographies, cover the 7 Associations representing the included scientific disciplines. The reports are as follows:

GEODESY

Geodetic Operations, by U.S. Coast and Geodetic

Survey.
SEISMOLOGY AND PHYSICS OF THE EARTH'S INTERIOR (including Tectonophysics)
Seismic Instruments, by Frank Press.
Changes in United States Seismograph Stations and Equipment, by L.M. Murphy.
Magnitude and Energy of Earthquakes, by B. Gutenberg.
Seismic Wave Propagation, by Frank Press.
Microseismic Research, by Dean S. Carder.
Geodetic Measurements Related to Crustal Movements and Particularly Earthquakes, by C. A. Whitten.
Current Developments in Seismological Research, by G.P. Woollard.
Advances in Seismic Exploration, by L. Y. Faust.
Gravity Tide Measurements, by Louis B. Slichter.
Flow, Fracture, and Strength of Rocks in the Laboratory, by John Handin.
Isostatic Compensation, and Origin of Continents and Mountains, by David T. Griggs.
Tectonic Theories, by Gordon J.F. MacDonald.
Application of Electronic Computers to Seismological Problems, by Freeman Gilbert.
Earth's Crust below the Oceans and in Continents, by Maurice Ewing.
Internal Constitution of the Earth; Physics of the Interior, by Francis Birch.
METEOROLOGY AND ATMOSPHERIC PHYSICS
The General Circulation of the Atmosphere, by Herbert Riehl.
Upper Atmosphere Studies, by William W. Kellogg.
Atmospheric Electricity, by D.R. Fitzgerald.
Chemistry of the Atmosphere, by C.E. Junge.
Research in Atmospheric Optics and Radiation, by Zdenek Sekera.
Arctic Meteorology, by R.G. Fleagle.
Polar Atmosphere, Antarctic, by Morton J. Rubin.
Tropical Meteorology, by C.L. Jordan
Cloud Physics, by Helmut Weickmann.
Climatology, by H.E. Landsberg.
Numerical Weather Prediction, by J.G. Charney.
Past Ice Ages, by William L. Donn.
Statistical Methods, by R.M. White.
Satellite Meteorology, by S. Fritz.
GEOMAGNETISM AND AERONOMY
General Geomagnetism, by J.H. Nelson.
Bibliography on General Geomagnetism, by David G. Knapp.
Geomagnetic and Geoelectric Variations, by S. Matsushita.
Solar-Terrestrial Relationships, by Walter Orr Roberts.
Ionospheric Research, by T.N. Gautier.
Auroral Spectroscopy, by Norman J. Oliver.
Auroral and Related Airglow Work at Yerkes Observatory, by J.W. Chamberlain.
Airglow Research, by F.E. Roach.
Chemistry of the Outer Atmosphere, by Francis S. Johnson.
Radiation Belts of the Earth, by James A. Van Allen.
Cosmic Radiation Research in the United States, by Peter Meyer.
PHYSICAL OCEANOGRAPHY
Equatorial Currents, by John A. Knauss.
Antarctic Oceanography, by Feodor Ostapoff.
Geochemistry of Ocean Water, by Wallace Broecker.
Surface Waves, by Willard J. Pierson, Jr.
Internal Waves, by C.S. Cox.
Tsunamis, by Wm. G. Van Dorn.
Storm Surges, by D. Lee Harris.
Marine Seismic Studies, by Russell W. Raitt.
Gravity at Sea, by J.C. Harrison.
Sea Floor Relief, by H.W. Menard.
Deep-Sea Sediments, by C. Emiliani.
VOLCANOLOGY (including Geochemistry and Petrology)
Volcanological Observations, by Irving Friedman.
Experimental Petrology, by J.F. Schairer.
Phase Relations of Some Rocks and Minerals at High Temperatures and High Pressures, by George C. Kennedy.
Geochronology, by Thomas L. Aldrich.
Changes in Wisconsin Glacial Stage Chronology by C^{14} Dating, by Meyer Rubin.
Cosmic-Ray Effects in Meteorites, by Alfred O. Nier.
Abundance and Distribution of Elements, by Michael Fleischer.
Stable-Isotope Geochemistry, by T.C. Hoering.
SCIENTIFIC HYDROLOGY
Precipitation, by F.A. Huff.
Erosion and Sedimentation, by M.G. Wolman.
Evaporation and Transpiration, by G.E. Harbeck, Jr.
Glaciers, by Mark F. Meier.
Ground Water, by Philip E. LaMoreaux and George B. Maxey.
Snow and Ice, by C.C. Warnick.
Surface Runoff, by A.J. Cooper.

--A.C. Mason.

3-1206. Schmeck, Harold M., Jr. NEW STUDY SHOWS WORLD ELLIPSOID: New York Times, v. 110, no. 37,637, p. 15, col. 3-6, Feb. 9, 1961.

New calculations, based on satellite tracking data, show that the trace of the equator is an ellipse, with the longer axis, by 1,400 ft., extending from a point in the Atlantic off the eastern tip of Brazil to a point near the Admiralty Islands.--M. Russell.

3-1207. Popov, E.I. THE DEPENDENCE OF THE ZERO-POINT DRIFT OF QUARTZ GRAVIMETERS ON THE THICKNESS OF FIBERS OF AN ELASTIC SYSTEM: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 499-500, table, 3 refs.

Certain regularities of zero point creep in Nørgaard and CH-3 gravimeters were observed and studied. It was found that this creep is due to viscosity of the quartz filaments used in the gravimeters, and that the magnitude of the creep is a function of the filament thickness. A suggestion is made that the observed effect would be even greater in elastic systems that use quartz glass for springs.--A.J. Shneiderov (courtesy Geophysical Abstracts 182-306).

3-1208. Thyssen-Bornemisza, Stephan, and W.F. Stackler. DETERMINATION OF THE HORIZONTAL GRAVITY GRADIENT WITH THE GRAVIMETER: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 10, p. 261-270, 7 figs. incl. graphs, table, Oct. 1960, 5 refs.

In recent years modern gravimeters have been perfected to such an extent that the measurement of gravity has become an extremely fast and simple method of exploration. The determination of the station elevation has been the most cumbersome and most expensive part of any modern gravity survey. In order to avoid the elevation problem it is proposed to measure the horizontal gravity gradient with the gravimeter. Preliminary field experiments over the Turner Valley structure indicate that this pro-

cedure may be quite successful and particularly applicable in remote areas such as the Canadian Arctic. It also may prove useful where former gravity surveys have to be supplemented and the old station locations are lost, so that a direct tying-in of additional gravity stations is not possible.--Auth.

3-1209. Gavrilov, L. I. THE GRAVITATIONAL POTENTIAL OF AN ELLIPTIC PARABOLOID: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 486-487, 4 refs.

A mathematical analysis of the gravitational potential of an elliptic paraboloid $(X^2/p)+(y^2/q)+2z_1=0$ is given. In this equation p is equal to a^2/c, $q = b^2/c$, where a and b are parameters of the paraboloid, and $c \rightarrow \infty$, $a \rightarrow \infty$, $b \rightarrow \infty$. Formulas derived for such a paraboloid indicate that only the value of $\sigma(pq)^{1/2}$ can be found from observations and that the Macloren's theorem of confocal ellipsoids is applicable to the case of elliptic paraboloids.--A. J. Shneiderov (courtesy Geophysical Abstracts 182-284).

3-1210. Paterson, Norman R. NEW METHODS OF ELEVATION CONTROL SPEED RECONNAISSANCE GRAVITY SURVEYS IN NORTHERN AREAS: Can. Mining & Metall. Bull., v. 53, no. 580, p. 614-622, 14 figs. incl. illus., maps, graphs, Aug. 1960, 7 refs.

Under certain conditions useful gravity information of a reconnaissance nature can be obtained without measuring elevations by spirit level surveys on the ground. Gravity surveys can become part of a practical exploration program where high cost and slow progress previously hindered their utility.

The advantages of the new elevation procedures are realized mainly in remote areas, in areas where ground transportation is slow and difficult, and on surveys where the station spacing is large in comparison with the distance of the average optimum level shot. To utilize the advantages, transportation by helicopter or light plane is usually necessary.

Methods of obtaining elevation control without levelling include: barometric altimeter survey; photogrammetric - APR spot determinations; methods involving the measurement of gravity gradients.

The accuracies of these methods have been tested and compared with the normal accuracy of level surveys. It is felt that each method has its place in reconnaissance gravity work, particularly in the open areas of northern Canada.--Auth.

3-1211. Lyakhov, B. M. EARTH'S MAGNETIC FIELD AS THE SUM OF FIELDS OF TWO DIPOLES: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 396-399, 3 maps, table, 5 refs.

The earth's magnetic field originates as the result of an eddy movement of highly ionized matter of the earth's core. It may be represented as the sum of the fields of 2 eccentric dipoles, which once more proves the existence of such movements. Inasmuch as the field of any eddy current may be represented as a magnetic dipole, then contrariwise, the field of a magnetic dipole can be represented as the field of an eddy current.

Considering the earth's magnetic field as the result of eddy current on the surface of the earth's core, the cause of the displacement of the residual field's anomalies becomes clear.

In the choice of precise parameters of dipoles, there may be raised the question of the unreality of worldwide anomalies, which, not constituting an objectively existing reality, originated only because that dipole (central or eccentric), according to which the main earth's field was computed, did not represent the true picture of motion in the core but only an averaged, total one, which is approximated more accurately by 2 dipoles.

For various periods, there may be a different combination of dipoles, and this means (which is very significant) that the cause of the principal earth's magnetic field and its secular variations are unified, i.e., these causes consist not only of eddy movements of matter in the earth's core, but also of displacements of these eddies.--Auth. concl.

3-1212. Strakhov, V. N. INTEGRAL METHODS FOR INTERPRETING ANOMALIES ΔZ HAVING LIKE SIGNS: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 345-350, 5 figs., 4 tables, 3 refs.

The actual testing of the integral methods for interpreting 2-dimensional magnetic anomalies ΔZ having like signs, suggested in this study, indicates that the best results were obtained for the third and the worst for the first method applied.

The theoretical evaluation of systematic errors involved in each of these methods shows the following: a) the errors caused by the finiteness of the interval of integration are more serious in the case when methods employing high powers of functions Z and H are applied; b) the errors involved in the determination of certain constants (limits) are considerably smaller when methods employing high powers of functions Z and H are used.

The results obtained from the practical and theoretical tests enable us to recommend the use of a relationship in interpreting 2-dimensional anomalies ΔZ, all having like signs.--Auth. concl.

3-1213. Lapina, M. I. ON CERTAIN RESULTS OBTAINED FROM THE STUDY OF VERTICAL GRADIENTS ON A MAGNETIC FIELD IN THE AREA OF THE KURSK MAGNETIC ANOMALY: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 390-395, 6 figs. incl. maps, profiles, 4 tables, 4 refs.

The computation methods I-V used in deducing $\partial Z/\partial h$ in the case of a 2-dimensional problem as well as the application of methods I and II for computing the averaged graphs in the Z-field in a 3-dimensional problem, make it possible to attain a 10% accuracy when the precision of the survey of Z is in the range of 0.5 - 1.0%.

Methods VI - VIII yield worse results compared with the methods I -V. Considering the difficulties encountered in choosing Δh, the accuracy of these methods can be estimated to be between 15 and 20%.

The methods of measuring Z at several levels with the purpose of determining the vertical gradients have shown in the area of the Kursk magnetic anomaly an accuracy up to 2-5%. In other areas where the maximum values of $\partial Z/\partial h$ are below 30 - 40 γ/m. these methods cannot yield satisfactory results because of the influence of the variations in the geomagnetic field and the changes in the temperature during the period of the observations of Z at different levels. In such cases the methods of computation are preferable to methods based on measure-

ments. The computations can be performed by any of the 5 methods I-V.--Auth.concl.

3-1214. Cox, Allan V. ANOMALOUS REMANENT MAGNETIZATION OF BASALT: U.S. Geol. Survey, Bull. 1083-E, p. 131-160, 12 figs., 1961, 34 refs.

Anomalous remanent magnetization in igneous rocks, defined as remanent magnetization obliquely oriented with respect to the field in which the rocks cooled, is often characterized by varying intensity and direction throughout a magnetized body. Cells of anomalous magnetization are defined as regions within which there exists a correlation between the remanent magnetization observed at any 2 points. For basalts of Pliocene and Pleistocene age from Idaho, cells of anomalous magnetization commonly have dimensions on the order of 25 ft.

A detailed study of one occurrence of anomalous magnetization indicates that the magnetization is isothermal and that it is due to the intense magnetic field accompanying a lightning discharge with a peak current of 22,000 amperes. Lightning is probably the most common cause of anomalous magnetization in the lava flows of Idaho. Most cells of anomalous magnetization due to lightning probably have dimensions on the order of 20-100 ft. Viscous magnetization causes a much smaller anomalous magnetization in these rocks.

Thermoremanent magnetization is relatively stable, but both types of anomalous magnetization can be selectively destroyed using alternating magnetic fields.--Auth.

3-1215. Stepanov, V.P. MAGNETIC ANOMALOUS FIELD OF THE TATAR ASSR AND ITS CONNECTION WITH THE GEOLOGIC STRUCTURE: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 476-479, map, 2 graphs, table, 9 refs.

A magnetometer survey of the Tatar A.S.S.R. and adjacent areas, completed at the end of 1957, has provided much data on the magnetic anomalies of the region. These data can be used to determine depth to basement in as much as all magnetic anomalies here are produced by the structure and petrographic composition of the crystalline basement rock.--A.J. Shneiderov (courtesy Geophysical Abstracts 182-428).

3-1216. Agocs, W.B., and others. INTERPRETATION AIRBORNE MAGNETOMETER-SCINTILLATION COUNTER SURVEY IN NORTHERN EXTENSION CHACHOENGSAO AREA OF THAILAND: 45 p., 8 figs. incl. illus., 2 maps (1 in pocket), Aero Service Corporation, Philadelphia, Pennsylvania, for Thailand, Royal Dept. of Mines, Thai Geological Survey, Oct. 1960, 6 refs.

The qualitative study of the geophysical data has indicated the presence of a large geosynclinal feature, the axis of which trends transverse to the regional geologic trend in Thailand.

The quantitative study shows that the maximum magnetite content for any of the analyzed bodies is probably not greater than 5%, but the areal dimensions of several of the bodies described in this report are sufficient to constitute a large hematite deposit. The proximity of these features to one another is also favorable.

The tabulation of anomalies included in this section lists the significant data obtained from the quantitative analysis.

The study of the reconnaissance profiles has indicated the magnitude of depth to the crystalline basement in the areas covered, as well as the location of possible structures such as faults and basement uplifts and the location of surface or nearsurface igneous masses. Such information is primarily useful in outlining areas of interest for the performance of detailed studies, either geophysical or geological, to locate accumulations of hydrocarbons, water, or evaporites.

The interpreted basement features deemed to be most significant from the standpoint of structural control of the overlying sediments are as follows: 1) The positive structure from kilometer 150 to 190 on profile H, which is associated with faulting to the east. 2) The broad structural high between kilometer 400 and 450 on profile I. 3) The indicated thickening of the sedimentary section northward toward the Mekong River on most of the profiles.--Auth. summ.

3-1217. Chetaev, D.N. THE DETERMINATION OF THE ANISOTROPY COEFFICIENT AND THE ANGLE OF INCLINATION OF A HOMOGENEOUS ANISOTROPIC MEDIUM, BY MEASURING THE IMPEDANCE OF THE NATURAL ELECTROMAGNETIC FIELD: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 407-408, fig., 6 refs.

A half-space $z' > 0$ filled with a uniform anisotropic conducting medium having a dip angle α is considered for determination of apparent specific resistivity around a point source of direct current placed on the surface of the medium, and a method is proposed for determining separately the angle α and the anisotropy coefficient of the medium from impedance of the natural electromagnetic field. A mathematical analysis of the problem results in an impedance modulus formula for various azimuths. The maximum of the modulus was found to be along the strike and the minimum across the strike of the deposit.--A.J. Shneiderov (courtesy Geophysical Abstracts 182-180).

3-1218. Slack, Howard A., and Carel Otte. ELECTRIC LOG INTERPRETATION IN EXPLORING FOR STRATIGRAPHIC TRAPS IN SHALY SANDS: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1874-1894, 9 maps, 2 diags., 2 logs, Dec. 1960, 14 refs.

Two quantities which can be calculated from conventional electric logs of shaly sands provide useful and reliable information on the reservoir rock and the fluid it contains. These quantities are the following. 1) Shaliness - a measure of the amount of disseminated clay material in the formation. This quantity measures the ease with which the rock gives up fluids and also makes an excellent mappable attribute for the construction of subsurface lithofacies maps. The agreement between this log-derived property and the results of cation exchange capacity measurements is good. 2) Saturation ratio - the ratio of mud filtrate saturation in the invaded zone to the interstitial water saturation in the non-invaded zone. The magnitude of this ratio is indicative of the amount of displaceable hydrocarbons in the formation.

The values of shaliness and saturation ratio when viewed together are related to the performance of the formation under production tests. Definite ranges in the values of these quantities are associated

with a) formations which produced hydrocarbons readily, b) formations which produced hydrocarbons in commercial quantities only when some form of artificial stimulation, such as sand fracturing, was applied, and c) formations which produced water along with the hydrocarbons.

A single favorability criterion is developed which is a joint function of shaliness and saturation ratio. This criterion based on electric log-derived quantities is a numerical estimate of the production performance of a formation. Its use in exploration is demonstrated by maps of its variation in shaly sand reservoirs of several oil fields. It may have value for detecting from dry-hole data the proximity to good oil production.--Auth.

3-1219. Brunelli, B.E., and others. MICROVARIATION STATION LSU AND THE RESULTS OF ITS OPERATION IN BOROK DURING THE SPRING OF 1959: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 443-447, 16 figs. incl. illus., diags.

Discusses the microvariation station constructed at Leningrad State University for recording short-period oscillations of the electromagnetic field of the earth. The advantage of the equipment is presented in comparison with other instruments used for the same purposes. First results are given of the operation of the microvariation station LSU during the spring of 1959 at the geophysical station of the Academy of Sciences, U.S.S.R. "Borok."--Auth.

3-1220. SEISMOLOGICAL NOTES: Seismol. Soc. America, Bull., v. 50, no. 2, p. 323-330, Apr. 1960.

Tabulates "Major and Great Earthquakes of 1958," determined (from all available date) by Beno Gutenberg. "Epicenters of the Larger Earthquakes of 1958" were determined and tabulated by the Jesuit Seismological Association. Also included are brief reports of approximately 100 areas in which earthquakes were cited for the period Oct. 21, 1959, through Feb. 29, 1960.--E. Aleshin.

3-1221. SEISMOLOGICAL NOTES: Seismol. Soc. America, Bull., v. 50, no. 3, p. 477-479, July 1960.

Lists approximately 50 areas of earth shocks for the period Feb. 29, 1960, through Apr. 29, 1960, with tabulation of pertinent data for disturbances near Honshu, Japan, from Mar. 20, 1960, to Mar. 31, 1960, and the New Hebrides Islands from Mar. 27, 1960, to Mar. 30, 1960.--E. Aleshin.

3-1222. SEISMOLOGICAL NOTES: Seismol. Soc. America, Bull., v. 50, no. 4, p. 609-612, Oct. 1960.

Lists 56 areas of earth shocks for the period May 1, 1960, through July 18, 1960, including tabulation of pertinent data for the larger shocks in the series of destructive earthquakes in central and southern Chile which began on May 21, 1960.--E. Aleshin.

3-1223. Duke, C. Martin. THE CHILEAN EARTHQUAKES OF MAY 1960: Science, v. 132, no. 3442, p. 1797-1802, 10 figs. incl. 7 illus., map, Dec. 16, 1960.

A general, semi-technical description of the effects of the Chilean earthquake of May 21-22, 1960. Methods used in investigating major earthquakes are described. The damage to man-made structures was extensive. Modification of the landscape is described.--F.P. Glasser.

3-1224. Pekeris, C.L., and others. COMPARISON OF THEORETICAL WITH OBSERVED VALUES OF THE PERIODS OF FREE OSCILLATION OF THE EARTH: Natl. Acad. Sci., Proc., v. 47, no. 1, p. 91-98, 6 tables, Jan. 1961, 19 refs.

The theoretical values of the periods of free oscillation of the earth, in both the spheroidal and torsional modes, are compared with the experimental values derived by Benioff, Press, and Smith from the seismograms (52 periods) and by Ness, Harrison, and Slichter from the gravimetric records (49 periods) of the Chilean earthquake of May, 1960. Two models of the earth are considered: model "Bullen B" and the "Gutenberg" model, the latter being characterized by the occurrence of a low-velocity layer at a depth of about 150 km. The periods deduced from power-spectra analyses of the seismic and gravimetric records are in mutual agreement to within 1%. The theoretical periods of spheroidal oscillations for the Gutenberg model agree with the observed values to within 1%, and this is true also for model Bullen B at periods less than 5 min. In the period range of 5 to 11 min., the observed values are systematically lower by about 2% than the Bullen B values, thus favoring the Gutenberg model.

As expected on theoretical grounds, no torsional oscillations were found in the spectrum of the gravimetric records. The torsional oscillations recorded on the seismograms agree in period to within 1% with both the Bullen B and Gutenberg values, except for the $\underline{n} = 2$ mode, which was, however, recorded weakly. An order-of-magnitude argument is presented in support of the hypothesis of the rotational origin of the frequency splitting of the free oscillations of the earth.--Auth. summ.

3-1225. Slichter, Louis B. THE FUNDAMENTAL FREE MODE OF THE EARTH'S INNER CORE: Natl. Acad. Sci., Proc., v. 47, no. 2, p. 186-190, graph, Feb. 1961, 8 refs.

The Chilean earthquake of May 22, 1960, furnished the first fully convincing observational evidence concerning the free modes of oscillation of the earth. It excited large response at long periods on both the LaCoste-Romberg earth-tide gravimeter and on Benioff strain seismometers. Of over 40 free modes to be identified, one spectral peak, with a period of about 86 min., had not been theoretically predicted and an explanation is needed. The observations made concern the period, amplitude, and energy loss of a mode whose deformations are confined to the "fluid" outer core. They suggest relationships indicated in the equation of motion for the mode ω_0

$$m_0(1 + \epsilon\rho_1\rho_0^{-1})(\ddot{\delta} + 2\alpha\dot{\delta}) + \{16\pi\beta a_0\mu + 4/3\pi\gamma m_0\rho_1(1 - \rho_1\rho_0^{-1})\}\delta = 0$$

where m_0 and a_0 are the mass and radius, respectively, of the inner core, α is the damping coefficient, γ is Newton's constant, and ϵ is a coefficient having value nearly one-half which takes account of the increased dynamic mass of the inner core. The observations also reveal the small value of the damping coefficient α and therefore the small degree of an-elasticity of this material when subject to small shear strains. Study of this inner-core oscillation provides new observational evidence about the earth's central region although identification of the material is still uncertain.--M. Russell.

3-1226. Vvedenskaya, A.V. DETERMINATION OF THE STRESSES ACTIVE IN THE FOCI OF EARTHQUAKES, BASED ON OBSERVATIONS AT SEISMOLOGICAL STATIONS: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 341-344, 3 figs., 4 refs.

A model of the fault forces, as established by the dislocation theory, is used for studying the stresses effective in the focus prior to the disruption of the continuity of the medium, and which are then released at the moment of the break. A method for determining these directions from the recordings of 2 or more seismological stations is introduced.--Auth.

3-1227. Savarensky, E.F., and others. ON THE DETERMINATION OF THE ENERGY OF ELASTIC WAVES GENERATED BY EARTHQUAKES: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 419-425, 10 figs. incl. diags., graphs, table, 13 refs.

The paper examines the question of the determination of the energy of body seismic waves from the data of distant stations, taking into consideration the nonuniformities in the emission by the focus. A device for the evaluation of the density of the energy by the seismogram is suggested. An example is adduced of the determination of the energy of the earthquake of Jan. 3, 1957.--Auth.

3-1228. Panassenko, G.D. ON DETERMINING THE ELEMENTS OF A SEISMIC RAY FROM THE DATA OF A SINGLE STATION: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 4, p. 361-366, 6 figs. incl. diag., graphs, table, 4 refs.

An evaluation is given of the errors in determining the azimuthal angle and the coefficient of the horizontal component of the displacement vector for a 3-component seismographic set-up as a function of the azimuthal angle. It is shown that the probability of these errors in relation to the least error at an azimuthal angle of 45° grows rapidly, as a function of the azimuthal angle. Conditions are given which guarantee a given accuracy in determining the azimuthal angle and the modulus of the horizontal component.

A 4-component system for an assembly of seismographs is proposed. Its advantage is shown over the 3-component system. Examples of determination of the azimuthal angle and the apparent angle of emergence of a seismic ray from records of a 4-component assembly of seismographs of a general type (D. P. Kirnos) at the seismographic station "Apatity" are discussed.--Auth.

3-1229. Kogan, S. Ya. ON THE DETERMINATION OF THE ENERGY OF SEISMIC WAVES OF ARBITRARY FORM: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 426-430, 3 figs., 4 refs.

A formula is obtained for the calculation of the energy of Rayleigh surface waves of arbitrary form, using the displacement and the velocity of displacement of the ground at the point of observation. This formula is derived on the basis of a general expression of the density of flow of energy. By way of an example of this general expression, the formula of Zoeppritz-Wiechert for the longitudinal body wave is obtained.--Auth.

3-1230. Kuhn, V.V. THE PECULIARITIES OF SEISMIC WAVES IN MEDIA WITH VERTICAL INTERFACES: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 434-442, 12 figs. incl. diags., seismograms, 2 tables, 12 refs.

The results of a study on 3-dimensional liquid-solid models of the peculiarities of seismic waves in media with vertical interfaces in the presence of a covering layer. An analysis is made of the dependence of the relative intensity of head and diffracted waves on the thickness of the covering layer and the ratios of the velocities and densities at the vertical boundary. Some examples are adduced of the comparison of the results of the study of media with vertical interfaces obtained both from models and in experimental field work.--Auth.

3-1231. Gretener, P.E.F. AN ANALYSIS OF THE OBSERVED TIME DISCREPANCIES BETWEEN CONTINUOUS AND CONVENTIONAL WELL VELOCITY SURVEYS: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 10, p. 272-286, 15 figs. incl. map, diags., graphs, Oct. 1960, 9 refs.

Discrepancies between conventionally obtained times and the integrated continuous velocity curves are analyzed (Shell tool only). It is found that these discrepancies may be ascribed to a random scatter and a systematic deviation, the integrated continuous curves being short. Possible causes of these discrepancies are discussed but no final explanation can be offered.--Auth.

3-1232. Broding, R.A., and J.L. Poole. COLLECTION AND PROCESSING OF DIGITIZED ACOUSTIC LOG DATA: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 10, p. 287-294, 8 figs. incl. illus., diags., Oct. 1960, 3 refs.; reprinted from: Geophysics, v. 25, no. 4, p. 939-947, Aug. 1960.

Abstract originally listed as GeoScience Abstracts 3-196.

The mathematical processes involved in making acoustic logs useful for the geophysicist or production analyst have prompted the handling of log data by digital means. Digital punched tape logs from retraced analog recordings as well as digital recordings made by punching tapes directly from the recording galvanometer signal obtained during a logging survey are being used as input to electronic computers. These computers can be programmed to perform the normal computations now used in data reduction. This process yields higher precision data and allows computational procedures to be performed that previously were considered burdensome or tedious. The technique is attractive in preparation of geophysical logs and synthetic seismograms, and calculating effective porosities and saturations. However, the requirement of converting recorded digital data, to be compatible with the input of different digital computers and to all the various formats for individual programs, is a problem that will require standardization in formats. It is evident that the advantages to be realized in data reduction processes will require the log of the future to be recorded in digital as well as analog form.--Auth.

3-1233. Rimmer, W.G. SEISMIC APPLICATIONS OF THE VELOCITY LOG: Alberta Soc. Petroleum Geologists, Jour., v. 8, no. 10, p. 295-302, 8 figs., Oct. 1960, 5 refs.

This paper deals with the use of the continuous

acoustic tool as a velocity log and its uses in seismic interpretation. The origin and identification of a reflection event are discussed together with the possibility of studying this origin from synthetic seismograms. Analogue technique synthesis is compared with electronically computed types of synthesis, and some conclusions regarding the future approach to this problem are given.--Auth.

3-1234. SEISMIC CRUSTAL STUDIES DURING THE IGY. PART II. CONTINENTAL PROGRAM: Am. Geophys. Union, Trans., v. 41, no. 2, p. 351-355, map, profile, June 1960; also pub. as: Natl. Acad. Sci., IGY Bull., no. 34.

Pt. 1 was listed as GeoScience Abstracts 3-858. The University of Wisconsin and the Dept. of Terrestrial Magnetism of the Carnegie Institution of Washington in the United States collaborated with IGY committees of Canada, Mexico, Chile, and Peru in the continental IGY Seismology Program. Large blasts set off during quarrying and mining operations were mostly used, although the Wisconsin seismologists exploded their own charges in the Great Lakes area. Measurements were carried out to distances beyond 300 km. to obtain first P-wave arrivals refracted from the underlying mantle rock.

In the Keweenaw Peninsula, consisting of basalt with some gabbro and granitic schist and gneiss, a profile parallel to geologic strike showed a thickness of 1.5 km. of material having a velocity of 4.7 km./sec., underlain by 34.5 @ 6.3, then mantle @ 8.05 km./sec. The Apostle Island (Lake Superior) profile at right angles to the previous and across a granitic dome, at the N. end where Precambrian clastic sediments predominate, showed a thickness of 2 km. @3.5 km./sec., underlain by 3@ 5.2, 32 @ 6.15, then mantle @ 8.15.

From a Little Rock quarry to Cape Giradeau, Missouri, the profile indicated 2 km.@ 4.65 km./sec. (chiefly Paleozoic carbonate sediments), 10 @ 5.5 (upper crust), 31 @ 6.9 (lower crust), then mantle @ 8.15. This 43-km. depth of mantle is in an area of low elevation and not under a mountain region where such a thickening of the crust would be expected. A profile extending SE. from an open-pit mine at Durango, Mexico, parallel to the Sierra Madre range, where volcanic tuffs overlie Mesozoic limestones, indicated a surface layer 0.5 km. thick having a velocity of 3.0 km./sec., then 3.5 @ 4.9, 40@ 6.0, and mantle @ 8.2.

Profiles along 10 azimuths extending from the Toquepala Cu mine about 60 mi. NW. of Tacna, Peru, did not obtain either refracted first arrivals or reflections from the base of the crust beneath the altiplano, but did indicate an apparent velocity layering of 5.3, 6.2, 6.7 (suggestion), and 8.2 km./sec., with the crustal thickness uncertain but computed as 46 km., or 65 km. on the basis of second arrivals. At Chuquicamata, 125 mi. NE. of Antofagasta, Chile, first arrivals also were not obtained from the base of the crust beneath the altiplano, but the profiles indicated velocity layering of 5.5, 6.0-6.4, 7.0, and 8.0 km./sec., with crustal thickness 56 km., or 70 km. on basis of second arrivals.--A.C. Mason.

3-1235. Cherdyntsev, V.V., and O.V. Suyarova. SOME DATA ON THE EFFECT OF GEOLOGIC CONDITIONS ON THE FORMATION OF THE TERRESTRIAL NEUTRON FLUX: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 97-100, 3 tables, pub. 1960, 3 refs.

Neutron flux was measured in several areas of Be concentration, on a glacier and in the laboratory. No intensification of neutron flux was detected in the area of pegmatite Be mineralization. Slow neutrons predominate in the flux, and they come chiefly from the atmosphere. Fast neutrons are beyond measurement.

No measurable flux of slow neutrons was detected, either in the glacier or in the laboratory. A sizable increase in the neutron flux was detected only in a zone of exceptional Be mineralization. This probably was due to 2 factors: a sufficiently strong flux of alpha particles and the presence of a neutron-generating substance.

This locality is the only known one where an increase in the terrestrial component of neutron flux lends itself to an interpretation by geologic conditions.--Auth. summ.

3-1236. Kogan, R.M. ON THE STATISTICS OF TRANSFORMATIONS IN A RADIOACTIVE SERIES: Akad. Nauk SSSR, Izvestiya, Geophysics Ser., in translation, 1960, no. 5, p. 448-451, 9 refs.

The statistical fluctuations in the decay of members of a radioactive series are considered. Formulas are given for the variance of the number of atoms of any daughter element disintegrating in a given time interval (t_1, t_2) and for the variance of combined number of decays among a group of daughter elements.--Auth.

3-1237. "WARM" WATER FOUND UNDER ICE OF TWO LAKES IN THE ANTARCTIC: New York Times, v. 110, no. 37,642, p. 33, col. 2-3, Feb. 14, 1961.

The water at depths of 50 ft. and deeper in ice-covered lakes Bonney and Vanda, near McMurdo Sound, is about 46°F., much warmer than normally to be expected. A possible explanation is a higher than normal heat flow from the ground below and around the lakes.--M. Russell.

3-1238. Mackay, D.G., and Norman R. Paterson. GEOPHYSICAL DISCOVERIES IN MATTAGAMI, QUEBEC: Can. Mining & Metall. Bull., v. 53, no. 581, p. 703-709, 10 figs. incl. maps, Sept. 1960.

The geology of the Mattagami mining camp, while of particular economic significance, is unfortunately obscured by a very thick mantle of overburden. For this reason geophysical methods have been relied upon heavily in exploring the area.

Geophysical data over 5 important sulfide discoveries show how targets are selected for drilling and how effective geophysics has been in assisting subsequent development programs.--Auth.

See also: Paleontology 3-1150; Igneous and Metamorphic Petrology 3-1274; Sedimentary Petrology 3-1307; Geohydrology 3-1324, 3-1325; Mineral Deposits 3-1333, 3-1334.

3-1239. Kuzmenko, M.V. THE GEOCHEMISTRY OF TANTALUM AND NIOBIUM: Translated by Michael Fleischer: Internat. Geology Rev., v. 3, no. 1, p. 9-25, 8 tables, Jan. 1961, 28 refs.

Ta and Nb are associated in nature. Both are oxyphile and are related geochemically to Fe, Mn, Ti, rare earths U, Th, Zr, W, Sn, Bi, and Sb. Both accompany the alkali metals, especially Na and Li. Their close relationship explains their isomorphism in mineral-forming processes. Zr, W, and Sn entrain Ta and Nb in the crystal lattices of their minerals in limited amounts. The concentration of Ta and Nb increases in the course of magma evolution from ultrabasic to alkalic. Nb predominates over Ta in the main kinds of rocks by from 5:1 to 17:1. Only in granite pegmatites is Ta dominant. In granitic rocks Ta and Nb are associated with Fe, Mn, Bi, Sb, W, and Sn. In granosyenitic complexes they form complex minerals with Ti, rare earths of the Y subgroup, U, and Th. Concentrations of Ta and Nb in granitic and granosyenitic complexes increase toward the end of the magmatic and pegmatitic processes, and afterward diminish toward the end of the pneumatolytic-hydrothermal processes. In alkalic complexes Ta and Nb are associated with Ti, rare earths of the Ce group, and Th. Concentrations of Ta and Ni in alkalic massifs are caused by magmatic differentiation. In alkalic ultrabasic complexes, in magmatic and pegmatitic processes, Ta and Nb do not form independent minerals but enter into minerals of Ti and Fe, i.e. perovskite, titanomagnetite, and pyroxenes.--M. Russell.

3-1240. Rosenfeld, John Lang. THE CONTAMINATION-REACTION RULES: Am. Jour. Sci., v. 259, no. 1, p. 1-23, 6 figs. incl. diags., graphs, 2 tables, Jan. 1961, 27 refs.

A graphical thermodynamic method is used to derive 6 "contamination-reaction rules." They relate the order of disappearance of phase assemblages to variations of temperature, pressure, and activities of mobile components when compositions change in a particular way.

Application is based on data readily ascertained in field and laboratory. The rules provide one possible analytical basis for the subdivision and arrangement of the mineral facies of rocks. They also emphasize the need for caution in applying results of experimental study of "clean" compositional systems to petrogenetic interpretation.--Auth.

3-1241. Amirkhanov, Kh. I., and others. THE MECHANISM OF RADIOGENIC ARGON LOSS IN MICAS: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 82-85, 4 figs., pub. 1960, 6 refs.

The loss of radiogenic Ar from micas, at temperatures as high as about 600°C., is a result of desorption type processes and is adequately described by the Langmuir isotherms. The Ar losses in micas, because of diffusion, become appreciable only at temperatures higher than about 600°C. At standard temperatures, the diffusion coefficient in micas should not exceed 10^{-31} cm.^{2}/sec.--Auth. concl.

3-1242. Wyllie, P.J., and O. Frank Tuttle. EXPERIMENTAL INVESTIGATION OF SILICATE SYSTEMS CONTAINING TWO VOLATILE COMPONENTS. PART II. THE EFFECTS OF NH_3 AND HF, IN ADDITION TO H_2O ON THE MELTING TEMPERATURES OF ALBITE AND GRANITE: Am. Jour. Sci., v. 259, no. 2, p. 128-143, 5 diags., 2 tables, Feb. 1961, 13 refs.

Addition of NH_3 to water-albite and water-granite mixtures at constant pressure raises the melting temperatures of albite and granite, whereas addition of HF to these mixtures causes marked lowering of melting temperatures. Results obtained at 2,750 bars pressure for charges containing 1:1 weight ratio of silicate to total volatiles are presented as perspective TX projections from within isobaric prisms onto the volatile faces of the prisms. In the presence of H_2O alone at 2,750 bars pressure, albite melts between 795°C. and 810°C., and granite begins to melt at 670°C.; in the presence of 8.2 weight percent NH_3 solution, the melting interval of albite is 805°C. to 825°C., and granite begins to melt at 690°C.; in the presence of 8 weight percent HF solution, the melting interval of albite is 610°C. to 685°C., and granite begins to melt at 595°C. No chemical reaction was detected in systems containing NH_3, but considerable reaction occurs with HF. With increasing HF concentration in the system $NaAlSi_3O_8$-H_2O-HF, quartz becomes a stable phase and the system is no longer ternary. In the presence of HF solutions, albite crystals grow much larger than in the presence of H_2O alone.--Auth.

Pt. I appeared as GeoScience Abstracts 2-2999.

3-1243. Glasser, F.P. THE SYSTEM Ca_2SiO_4-Mn_2SiO_4: Am. Jour. Sci., v. 259, no. 1, p. 46-59, 2 diags., 2 graphs, 2 tables, Jan. 1961, 15 refs.

Results of quenching experiments on mixtures lying along the Ca_2SiO_4-Mn_2SiO_4 join of the CaO-MnO-SiO_2 system are presented. The O partial pressure was controlled to maintain Mn as Mn^{2+}. The system Ca_2SiO_4-Mn_2SiO_4 is not entirely binary because of the incongruent melting of a range of compositions to (Ca, Mn) O solid solutions and liquid. The departure from binary melting behavior is, however, slight.

Liquidus temperatures drop sharply from Ca_2SiO_4 (~2,130°) to a liquidus invariant point at 1,375° involving: liquid (45.5 wt.% Mn_2SiO_4), αCa_2SiO_4, and $\alpha' Ca_2SiO_4$ solid solutions. With further increase in Mn_2SiO_4, liquidus temperatures fall more slowly to another invariant point involving $\alpha' Ca_2SiO_4$, tephroite (Mn_2SiO_4) solid solutions, and liquid (72% Mn_2SiO_4) at 1,257°: and thence through a minimum at 75.5% Mn_2SiO_4 and 1,204°, before rising to the tephroite end at 1,345°.

The compound $CaMnSiO_4$ (glaucochroite) forms a complete series of solid solutions with tephroite and a limited series of solid solutions with Ca_2SiO_4. γ Ca_2SiO_4 and Mn_2SiO_4 are not completely miscible.--Auth.

3-1244. Garrels, Robert M., and others. CONTROL OF CARBONATE SOLUBILITY BY CARBONATE COMPLEXES: Am. Jour. Sci., v. 259, no. 1, p. 24-45, 8 graphs, 3 tables, Jan. 1961, 18 refs.

Activity coefficients of HCO_3^- and CO_3^{--} were determined in aqueous solutions of NaCl, $MgCl_2$, and of NaCl-$MgCl_2$ mixture of approximately the same mol ratio as sea water. The values obtained in "synthetic sea water" correspond to those observed in actual sea water.

The data for CO_3^{--} are interpreted in terms of

2 complexes:

$$\frac{a_{Mg^{++}} \; a_{CO_3^{--}}}{a_{MgCO_3^{\circ}}} = 4.0 \times 10^{-4}$$

$$\frac{a_{Na^{+}} \; a_{CO_3^{--}}}{a_{NaCO_3^{-}}} = 5.4 \times 10^{-2}$$

Calculations show that of the total CO_3^{--} in sea water, as determined by titration and not including HCO_3^-, about 75% is $MgCO_3^\circ$, 15% $NaCO_3^-$, and 10% free CO_3^{--}.

The data for HCO_3^- also indicate the presence of complexes of Na^+ and Mg^{++}, but these are less strongly associated, and are not fully characterized.

It is shown that the concentration of Ca^{++}, in equilibrium with calcite, is greater in "synthetic sea water" than in Mg-free NaCl solutions. The observed apparent supersaturation of sea water in calcite is not fully explained here. Although the total concentration of CO_3^{--} in sea water can be predicted from these data, that of Ca^{++} cannot.--Auth.

3-1245. Ringwood, A.E. COHENITE AS A PRESSURE INDICATOR IN IRON METEORITES: Geochim. et Cosmochim. Acta, v. 20, no. 2, p. 155-158, table, Oct. 1960, 11 refs.

Meteoritic irons are regarded as having cooled very slowly through the 1,000°-700°C. region and continue to be cooled slowly beyond this range. Under such long annealing periods cohenite $(FeNi)_3C$ would have completely decomposed to Fe and graphite under ordinary conditions. The only explanation for the occurrence of cohenite in meteorites is that they have crystallized under pressures exceeding 25,000 atmospheres. This indicates that meteoritic irons crystallized deep within a parent body of approximately lunar size.--F. Manheim.

3-1246. Baker, George. COMMENTS ON THE RECENT LETTER ON "MOLDAVITES AND SIMILAR TEKTITES FROM GEORGIA, U.S.A.": Geochim. et Cosmochim. Acta, v. 19, no. 3, p. 232-233, July 1960.

Australites should not be generally regarded as having retained delicate surface features; in fact, those found in Australian desert areas have lost nearly all of their primary and secondary sculpture features due to subaerial erosion. Only in the more temperate regions of the australite strewnfield are cases of good preservation recorded. It is emphasized that the distribution of australites over the Australian continent is uneven.

Those tektites known as moldavites do not come from Moldavia. They were named for the township of Moldava and are found in Moravia and Bohemia.--F. Manheim.

3-1247. Chentsov, I.G. THE ENTRY OF URANIUM INTO SOME ROCK-FORMING MINERALS. Translated by Michael Fleischer: Internat. Geology Rev., v. 3, no. 1, p. 5-8, 2 tables, Jan. 1961, 7 refs.

Samples of 3 Tien Shan granites were analyzed for the U content of their constituent minerals. Three minerals with high U content are allanite (450-500 p.p.m.), monazite (1,000-1,300 p.p.m.), and zircon (1,600-1,860 p.p.m.), but significant amounts, from 20 to 40 p.p.m., occur in the biotite, muscovite, amphibole, apatite, ilmenite, sphene, and chlorite. From 30 to 60% of the total U in the granites could be leached from the minerals. The unleachable portion of U may enter the crystal lattices of minerals by isomorphism or endocryptism. --M. Russell.

3-1248. Rushton, B.J. BERYLLIUM IN TANGANYIKA GRANITIC ROCKS: Geochim. et Cosmochim. Acta, v. 20, no. 2, p. 154-155, table, Oct. 1960, 3 refs.

Detection of Be in Tanganyikan granites and granodiorites is reported. Be was more frequently detected in granites than granodiorites and most frequently in late orogenic granites. The concentrations are generally less than the granitic averages used by Sandell and correspond more nearly to those of Norton.--F. Manheim.

3-1249. Petersile, I.A. HYDROCARBON GASES AND BITUMENS IN INTRUSIVE MASSIFS OF THE CENTRAL KOLA PENINSULA: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 42-47, 2 graphs, 4 tables, pub. 1960, 7 refs.

Alkaline extrusives of the Khibiny and Lovozero plutonic massifs contain hydrocarbon gases, close to those of oil-gas areas. These gases contain 80 to 98% methane and 20 to 22% heavy C_2-C_4 hydrocarbons.

Basic to ultrabasic rocks of the Monche-tundra massif carry no hydrocarbon gases, with the exception of a small amount of methane. The similarity of the geologic structure of the Monche-tundra and Lovozero massifs suggests that the difference in the hydrocarbon-gas content of their component rocks is the result of a difference in the magma composition.

The direct relationship between the chemical composition of rocks and their hydrocarbon gas content suggests an inorganic origin for the latter. The observed regularity in change of the hydrocarbon gas content in the Khibiny rocks, as a function of their Al content, makes it possible to formulate a fairly well-substantiated hypothesis as to their origin. An alkaline molten solution had all the prerequisites for generating hydrocarbon gases, a reducing environment and a high temperature. H could have been generated by action of water steam on ferrous-Fe compounds. This is known to produce hematite or magnetite and free H. This reaction is reversible and proceeds with a fair intensity up to 500°C. Methane could have been formed through synthesis of C and H. This is suggested by the relation of the hydrocarbon gas content and the Al concentration in rocks. Al is the catalytic agent in this case. H and hydrocarbon gases were generated during the intrusion and crystallization of the alkaline molten solution.

Alkaline rocks of the Khibiny and Lovozero massifs contain reduced bitumens in microfractures and rock pores.

The consistent relation between hydrocarbon gases and bitumen in rock, suggests the latter's formation through polymerization of saturated hydrocarbons.--Auth. summ.

3-1250. Nicholls, G.D. TECHNIQUES IN SEDIMENTARY GEOCHEMISTRY: (2) DETERMINATION OF THE FERROUS IRON CONTENTS OF CARBONACEOUS SHALES: Jour. Sed. Petrology, v. 30, no. 4, p. 603-612, sec., 3 graphs, table, Dec. 1960, 20 refs.

A method is described for the determination of ferrous Fe contents in shales containing organic matter up to 4% C equivalent. After initial attack on the shale the ferrous Fe is made to react with iodine monochloride and the liberated iodine titrated against standard potassium iodate. The value of ferrous Fe determinations in shales is illustrated by consideration of the composition of various members of a British Coal Measure cyclothem.--Auth.

3-1251. Gorham, Eville. THE RELATION BETWEEN SULFUR AND CARBON IN SEDIMENTS FROM THE ENGLISH LAKES: Jour. Sed. Petrology, v. 30, no. 3, p. 466-470, 4 tables, Sept. 1960, 11 refs.

Total S and total C have been analyzed in freshwater sediments from the English Lake District. The 2 elements are closely correlated, but C/S ratios are lower in reducing than in oxidizing muds, and much lower in fertile than in infertile lakes. These ratios also vary considerably in sediment cores from a fertile and an infertile lake, being maximal during and just after the phase of most rapid increase in organic content.--Auth.

3-1252. Galle, O. Karmie, and Russell T. Runnels. DETERMINATION OF CO_2 IN CARBONATE ROCKS BY CONTROLLED LOSS ON IGNITION: Jour. Sed. Petrology, v. 30, no. 4, p. 613-618, 4 figs., 2 tables, Dec. 1960, 5 refs.

A method which uses a controlled loss on ignition for the determination of CO_2 in carbonate rocks was developed to provide a simple and reliable means of producing results from a group of samples at the same time. The routine loss on ignition was modified slightly to include 2 steps instead of one. A loss of 550°C. is recorded as well as the loss at 1,000°C. Thus, by accurately controlling the temperature, values were obtained for the carbonate and noncarbonate portions of the loss on ignition. The method is demonstrated to be rapid and as reliable as acid evolution methods. Differential thermal analysis technique was used to aid in time and temperature selections. DTA curves, experimental data, and procedures are shown.--Auth.

3-1253. El Wardani, Sayed A. TOTAL AND ORGANIC PHOSPHORUS IN WATERS OF THE BERING SEA, ALEUTIAN TRENCH AND GULF OF ALASKA: Deep-Sea Research, v. 7, no. 3, p. 201-207, chart, graph, 3 tables, Dec. 1960, 11 refs.

Total P was determined on some 170 samples from 11 stations in the Bering Sea, the Aleutian Trench, and the Gulf of Alaska. Samples ranged in depth from the surface to 7,000 m. In these samples organic P, estimated as the difference between total and inorganic P, bears an inverse relationship to the distribution of inorganic P. Surface waters, generally low in inorganic P, contain up to 1.0 μg. at./L organic P, with a grand average of 0.27 μg. at./L for the upper 200 m. The amount of organic P present in surface waters reaches values as high as 47% of the total. On the other hand, waters below about 200 m. have little or no measurable amounts of organic P. In its vertical distribution, total P varies at the most by a factor of 3 and is more or less uniform with depth compared to the inorganic P. Inferences are drawn concerning the nature of organic matter and the state of organic P in deep waters. The observed distribution of various forms of P substantiates the theory that the major part of the P cycle is enacted in the surface layers.--Auth.

3-1254. Barkley, Richard A., and Thomas G. Thompson. THE TOTAL IODINE AND IODATE-IODINE CONTENT OF SEA-WATER: Deep-Sea Research, v. 7, no. 1, p. 24-34, 3 figs. incl. map, table, Aug, 1960, 16 refs.

Iodine in sea-water samples from the NE. Pacific and Arctic oceans was determined by 2 independent methods of analysis, one of which was also capable of determining iodate. Both oceans showed a constant iodine-chlorinity ratio of 3.3×10^{-6} at depths from 250-4,000 m. Some significant variation was observed in the iodine-chlorinity ratio in the surface layers. In the N. Pacific from one- to two-thirds of the total iodine was present as iodate, with no discernible trends with depth or location. In the Arctic, the iodate increased with depth - from a minimum near the surface to a maximum at 500-1,000 m., where 100% of the iodine was found to be iodate. More iodate was present in the Arctic from 200-2,000 m. than was present in any N. Pacific sample.

Inland waters of the State of Washington showed iodine-chlorinity ratios about 15% lower than oceanic stations, probably due to accumulation of iodine by benthonic algae.--Auth.

3-1255. Blinov, L.K. THE SALT BALANCE OF THE ARAL SEA. Prepared by Research International Associates: Internat. Geology Rev., v. 3, no. 1, p. 26-41, 2 maps, 12 tables, Jan. 1961, 48 refs.

In the Aral Sea there exists an excess of influx of salts over loss by deposition, yet there has been no appreciable increase in the salinity of the sea since 1871. Loss of water by evaporation is less than influx by drainage, hence influx of ground water cannot explain it. A method for calculating the salt loss from interior basins by wind is described and analyzed mathematically. Only 0.05% of the salt carried in by river drainage is lost through the action of wind. Outflow of saline water by filtration through the sandy shores along the coasts is shown to be a factor explaining salt loss and the maintenance of salinity equilibrium.--M. Russell.

3-1256. Lebedev, V.I. ON THE CAUSES OF THE OXIDATION OF URANIUM IN URANINITES. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 1, p. 1-4, diag., Jan. 1961, 10 refs.

This article introduces a refinement into calculations of absolute geologic age by the U-Pb isotope method, by showing that the over-all rate of auto-oxidation of U in uraninites is accelerated in the peripheral parts of uraninite crystals, and that the age determinations based on the radioactive decay of uraninite are thus somewhat exaggerated. In the outer layers of the crystals, from which He^{++} ions and e^- electrons can escape into the surrounding medium, the rate of oxidation of U, and hence of its ultimate transformation into Pb, is increased by the dissociation of water and absorption of O^{2-} ions by U and Pb cations, through the action of the escaping α- and β - radiation. Under certain conditions the processes in the intensively oxidized outer layers may also involve reduction of some UO_3 to UO_2, and the secondary formation of galena segregations with H_2S is present, in the surrounding solutions.--P.T. Broneer.

3-1257. Dansgaard, W. THE CONTENT OF HEAVY OXYGEN ISOTOPE IN THE WATER MASSES OF THE PHILIPPINE TRENCH: Deep-Sea Research, v. 6, no. 4, p. 346-350, diag., table, 1960, 8 refs. The H_2O^{18} content of a group of 11 water samples from 7,558 to 9,864 m. depth was compared with that of another group of 4 samples from 3,830 to 4,202 m. depth. The difference was 0.1 ± 0.2 p.p.m., i.e. not significant. Approx. 100 p.p.m. should be expected in case of equilibrium.--Auth.

8. MINERALOGY AND CRYSTALLOGRAPHY

See also: Geochemistry 3-1245; Igneous and Metamorphic Petrology 3-1286; Sedimentary Petrology 3-1293, 3-1294, 3-1304, 3-1305; Mineral Deposits 3-1345.

3-1258. Cassidy, M.M., and C.J. Mankin. CHLOROX USED IN PREPARATION OF BLACK SHALE FOR CLAY MINERAL ANALYSIS: Oklahoma Geology Notes, v. 20, no. 11, p. 275-281, 4 figs., Nov. 1960, 5 refs.

Organic content is particularly troublesome in detailed clay-mineral analysis of black shale by X-ray diffraction. Removal of the organic material by heating in a stream of O, oxidation by hydrogen peroxide, and solution by organic solvents are the 3 methods now commonly employed.

A new method involving the use of Chlorox (sodium hypochlorite) has been devised. X-ray diffraction studies of reference clays both before and after treatment show no significant alteration of the clay structure, providing the specified procedure is followed. X-ray diffractograms obtained from representative black shale samples both before and after the specified treatment show the presence of small amounts of clay minerals completely masked by the organic material. This procedure overcomes most of the objectionable characteristics of the 3 methods now in use. --C.J. Mankin.

3-1259. Hughes, Paul W., and others. MINERALOGICAL ANALYSIS OF CARBONATE ROCKS BY X-RAY DIFFRACTION: Jour. Sed. Petrology, v. 30, no. 4, p. 619-622, 5 graphs, table, Dec. 1960.

Many minerals can be identified by X-ray diffraction from polished rock slices cut to fit in the sample holder of a diffractometer. Scanning from 20° to 35° 2θ gives the strong reflections of common minerals. Typical diffractometer patterns of limestones and dolomites are given.--D. Carroll.

3-1260. Greenberg, Seymour S. OUTGROWTHS OF AUTHIGENIC BROOKITE ON LEUCOXENE GRAINS IN PENNSYLVANIAN AND LATE MISSISSIPPIAN SANDSTONES OF INDIANA: Jour. Sed. Petrology, v. 30, no. 4, p. 622-623, illus., table, Dec. 1960, 2 refs.

Photomicrographs show well crystallized brookite outgrowths on leucoxene grains. Optical data for brookite are given.--D. Carroll.

3-1261. Hess, H.D. FERSMITE: A RARE CALCIUM COLUMBATE MINERAL FROM MONTANA: U.S. Bur. Mines, Rept. Inv. 5693, 9 p., 2 illus., 4 tables, 1960, 5 refs.

The new locality for fersmite described in this report in Ravalli County, Montana, represents the first recorded occurrence of this rare calcium-columbate mineral in North America and only the second reported occurrence in the world. Particularly interesting is the fact that Montana fersmite is associated with a Ta-free columbite and that fersmite itself is free of Ta, suggesting that the material could be of special metallurgical interest.--Auth. concl.

3-1262. Campbell, F.H., and R.S. Mitchell. SAND-CALCITE CRYSTALS FROM STONEHAM, COLORADO: Rocks & Minerals, v. 36, no. 1/2, p. 18-21, 3 illus., table, Jan.-Feb. 1961, 12 refs.

Aggregates of small sand-calcite crystals occur in white sandstone in the sedimentary formations of the well-known blue barite locality near Stoneham, Weld County, Colorado. Beds of sandstone containing sand-calcite and clay beds of altered volcanic ash containing barite are assigned to the Tertiary (Oligocene). Sand-calcite crystals consist largely of clastic quartz cemented with calcite, but black biotite, microcline, plagioclase, and hornblende are also present; small amounts of apatite, sericite, and kaolinite have been detected. Samples digested in HCl indicate average composition as follows: calcite 41.4%, clastic material 58.6%. Averages are compared to those determined upon sand-calcite crystals from other localities. A table of 10 sand-calcite localities in the United States is given, containing locality, crystal form, and age of formation, plus references.--J. Sinkankas.

3-1263. Swift, Ellsworth R. CRYSTALS BY THE DITCHFUL: Rocks & Minerals, v. 36, no. 1/2, p. 22-26, 3 illus., map, Jan.-Feb. 1961.

Since 1958, well-formed single crystals and rosettes of gypsum (selenite) crystals have been recovered from a bed of Cretaceous Patapsco clay exposed during bulldozing for road work along the shore of Potomac River near Fort Foote in Prince Georges County, Maryland. Patapsco clay outcrops in many places in the vicinity of Washington, D.C., a well-known locality being at Fort Washington, approximately 5 mi. S. of the Fort Foote locality and about 8 mi. S. of the District of Columbia boundary on the eastern side of the Potomac River. Crystals of selenite range in size from a fraction of an inch to about 4 in. in length; single crystals are far less common than rosettes. The author advances a theory to explain the genesis of the crystals in the light of the structure and position of alluvium of the Coastal Plain as exposed in the vicinity.--J. Sinkankas.

3-1264. Mankin, C.J., and M.M. Cassidy. CHLORITE, VERMICULITE, AND TALC FROM WEBSTER, NORTH CAROLINA: Oklahoma Geology Notes, v. 20, no. 10, p. 261-266, 7 figs., incl. map, sec., Oct. 1960, 7 refs.

Chlorite, vermiculite, and talc are present as alteration products of a dunite deposit. X-ray diffraction data show that samples of the serpentinized zone contain a mixture of chlorite and vermiculite as separate mineral phases. Emission spectrometer data do not confirm that the chlorite is high in Ni as had been previously reported, but rather indicate

that it is a normal Mg variety. Treatment of these samples by 1N HCl (commonly used as a standard test for chlorite) is not reliable for the Webster material. The result of this treatment is the destruction of the vermiculite while the chlorite remains unaffected.

Samples from the vermiculite-talc contact zone are composed of a mixture of vermiculite and talc as separate mineral phases. The vermiculite contains some Ni but Mn is also present in appreciable quantities. The talc contains no unusual abundance of trace elements.

The field relationships for these 3 minerals demonstrate that they are a result of hydrothermal alteration of the dunite intrusion.--C.J. Mankin.

3-1265. Carnahan, Veryle. THE TREASURE OF THE HIMALAYA MINE: Gems & Minerals, no. 278, p. 21-25, 55, 56, 57, 25 illus., Nov. 1960.

Recent mining for gem tourmaline and associated pegmatite pocket minerals are described in a popular-type article. A brief history of the Himalaya Mine at Mesa Grande in San Diego County, California, is furnished along with descriptions of present mining methods and removal of pocket minerals. Well crystallized stibiotantalite, hambergite, cassiterite, columbite-tantalite, as well as tourmaline, quartz and microcline have been obtained.--J. Sinkankas.

3-1266. Beveridge, Alexander J. HEAVY MINERALS IN LOWER TERTIARY FORMATIONS IN THE SANTA CRUZ MOUNTAINS, CALIFORNIA: Jour. Sed. Petrology, v. 30, no. 4, p. 513-537, 11 figs. incl. map, graphs, 3 pls., table, Dec. 1960, 24 refs.

A total of 38 heavy minerals were found in Butano (Eocene), San Lorenzo (Oligocene), and Vaqueros (Miocene) formations in the Santa Cruz Mountains, but of these, only 13 occur in appreciable amounts. They are: apatite, biotite, chlorite, epidote, garnet, hematite, ilmenite, leucoxene-anatase, pyrite, rutile, sphene, tourmaline, and zircon.

Stratigraphic variations of heavy mineral frequencies in the Butano and Vaqueros formations are significant through both vertical and horizontal intervals. The San Lorenzo formation, however, is dominantly shale, and the percentages of heavy minerals therein are too low to allow detailed study. The mineral variations in the Butano and Vaqueros sands are attributed to 4 main processes: 1) differential sorting, 2) concentration of stable minerals by removal of unstable species, 3) diagenetic alteration, and 4) changes in intensity of erosion and weathering at the source plus changes in mode of transport to the site of deposition.

Diagenesis, which plays an important role in the alteration of ilmenite and sphene to leucoxene (or anatase), appears to have been more active in the northernmost sections of these formations, where increased distance from shore and source of sediments may have been a controlling factor in mineral alterations.

The main distributive province from which the heavy minerals of these lower Tertiary sedimentary rocks were derived is the area in which the Ben Lomond quartz diorite and adjacent metamorphic rocks occur. A secondary terrane which appears to have made a minor but significant contribution to early Tertiary sedimentation in this area is the pre-Tertiary (Franciscan) sedimentary, metamorphic, and basic igneous terrane NE. of the San Andreas fault.--Auth.

3-1267. Sunderman, Jack A., and Seymour S. Greenberg. MINERALS ASSOCIATED WITH LOWER PENNSYLVANIAN CONGLOMERATE, LAWRENCE COUNTY, INDIANA: Jour. Sed. Petrology, v. 30, no. 4, p. 578-581, map, 2 figs., Dec. 1960, 6 refs.

Hydrated and dehydrated halloysite, allophane, crandallite, gibbsite, kaolinite, iron oxides, manganese wad, and barite are associated with quartz conglomerate of the early Pennsylvanian Mansfield formation in southwestern Lawrence County, Indiana. Halloysite is found as lenses in the conglomerate and as rounded particles as large as pebble size. Allophane is found in lenses and exhibits columnar and botryoidal structures. Crandallite has formed at the expense of allophane. Manganese wad is found both as coatings on quartz pebbles and as pebble-free lenses as much as 6 in. thick. Most lenses of wad contain gibbsite and hydrated halloysite. Kaolinite occurs as rounded pebbles and as irregular particles between quartz pebbles. Iron oxides appear as irregular bands and stainings throughout the conglomerate. Two layers of well crystallized barite, each half an inch thick, are found about 200 yards SW. of the quarries at the contact of a Mississippian limestone and overlying red clay and quartz pebble residuum.--Auth.

3-1268. Michigan, Geological Survey Division. MINERALOGICAL GUIDE: 3d ed., 31 p., illus., map, 1960, refs.

The first edition of this guide, published in Apr. 1958, was needed in response to queries following a mineral show on the Dept. of Conservation TV program "Michigan Conservation." The second edition, July 1959, was characterized by the addition of the section on gem stones. The present edition is another major revision. It contains the following information: 1) map of Michigan's mineral extracting industries; 2) general information on mineral collecting and lapidary work; 3) Michigan's gem stones; 4) assays and tests of minerals; 5) bibliography of articles relating to Michigan, periodicals dealing with minerals, mineral collecting, and lapidary work, mineralogical books; 6) list of mineral and lapidary societies in Michigan; 7) geological exhibits in public museums.--A.C. Sangree.

3-1269. Howery, S.D., and others. AUTHIGENIC APATITE AND MAGNESIUM CLAY FROM CADDO COUNTY, OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 8, p. 187-190, 3 illus., Aug. 1960.

A new mineral of the apatite group occurs as authigenic nodules in the upper Marlow and lower Rush Springs formations (middle Permian). It is found as cavity linings and solid nodules, 0.5 - 2.5 in. in diameter. Incomplete chemical analyses show that the mineral is mainly calcium phosphate with significant Na, SO_4, CO_2, F, and Cl. Associated with the apatite and elsewhere in the area is an authigenic clay in the lower 50 ft. of the Rush Springs sandstone. The clay occurs as concretionary cement, in which the individual masses are 0.5 - 1.0 mm. in diameter. X-ray, chemical, and optical studies show it to be a Mg clay mineral of the chlorite type. The origin of the apatite and the clay is believed to be from saline waters approaching the threshold of evaporite deposition.--C.J. Mankin.

3-1270. Lovett, F.D., and others. AUTHIGENIC APATITE AND CLAY MINERALS FROM ROGER

MILLS COUNTY, OKLAHOMA: Oklahoma Geology Notes, v. 20, no. 8, p. 190-194, 3 illus., Aug. 1960.

Small concretionary clusters of authigenic apatite and authigenic overgrowths on detrital grains of apatite were recently discovered in Permian sandstones. These minerals were found in 2 localities approximately 18 ft. above the base of the Cloud Chief formation. The clusters are composed of anastamosing, needlelike bundles of clear apatite crystals, with indices of refraction: $\omega = 1.643 \pm 0.003$; $\epsilon = 1.638 \pm 0.003$. Overgrowths on the detrital grains were in complete continuity with the central core.

Two types of authigenic clay minerals were also found at one locality. One is a white Mg clay occurring as cavity encrustations, veinlets, and small nodules in the same unit as the apatite. The other is a white to light-gray, waxy, Mg-Ca montmorillonite which occurs as a discontinuous layer 0.5-1 in. thick, 20 ft. above the base of the Cloud Chief formation.--Auth.

3-1271. Ray, Satyabrata, and H.R. Gault. MINERALOGY OF JACKSONBURG (MIDDLE ORDOVICIAN) FORMATION IN EASTERN PENNSYLVANIA AND WESTERN NEW JERSEY: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 1, p. 39-50, map, 2 secs., 7 tables, Jan. 1961, 48 refs.

The mineralogy of the Middle Ordovician Jacksonburg limestone formation in eastern Pennsylvania and western New Jersey is simple and almost monotonously uniform.

Calcite is the predominant mineral. There is a small amount of dolomite. Quartz and mica minerals (1M, 2M muscovite and possibly biotite) occur throughout the formation. Each of them constitutes 30-40% of the acid-insoluble residue, which in turn makes up 15-40% of the rock. The insoluble residue also contains well crystallized, ferriferous chlorite minerals ranging from a trace to about 15-20%; montmorillonite minerals occurring sporadically up to about 10%; 5-10% of sodic feldspar; pyrite in amounts generally less than 5%; and nongraphitic carbonaceous material constituting a maximum of 5%.

The bulk of the Jacksonburg is characterized by the presence of chlorite. A chlorite-poor unit 50-80 ft. thick overlies the Jacksonburg-Beekmantown contact. This unit occurs within whatever stratigraphic subdivision or facies happens to be present at this position. There may be a chlorite-poor unit at the top of the Jacksonburg formation.

The chlorite-poor units of the Jacksonburg formation may represent shallow marine deposits with the bulk of the formation having been deposited in deeper water which provided more opportunity for diagenetic alterations of detrital illite and montmorillonite to chlorite. The presence of chlorite in the Jacksonburg in small areas isolated from the main belt suggests that the formation was deposited in an extensive sea rather than in isolated small basins and that the present outcrop pattern is the result of erosion.

The high degree of crystallinity of the clay minerals is a result of post-depositional stress deformation. Montmorillonite is attributed to minor admixtures of volcanic ash. The absence of kaolinite from the Jacksonburg formation may indicate a lack of kaolinite from the source area since the diagenetic alteration of kaolinite requires much slower deposition than seems probable, at least for the chlorite-poor units.--Auth.

9. IGNEOUS AND METAMORPHIC PETROLOGY

See also: Areal and Regional Geology 3-1076, 3-1080; Structural Geology 3-1118; Stratigraphy 3-1142, 3-1144; Geochemistry 3-1249; Mineralogy 3-1264.

3-1272. Williams, Howel. THE FLOOR OF CRATER LAKE, OREGON: Am. Jour. Sci., v. 259, no. 2, p. 81-83, map, 2 secs., Feb. 1961, 4 refs.

Soundings recently made of the floor of Crater Lake by the U.S. Coast and Geodetic Survey show a maximum depth of 1,932 ft. They reveal the presence of a submerged cone, 1 mi. across at the base and approximately 1,320 ft. high, from which flows spread southeastward to form an extensive lava plain. The soundings also reveal a submerged field of lava extending 2 mi. eastward from Wizard Island, a small mound protruding above its surface. Samples dredged from the flank of the cone consist of hypersthene-augite andesite; samples from the mound consist of vitrophyric hypersthene-hornblende dacite. Arcuate fault planes enclose the caldera, but no fault scarps cross the floor, and there are no signs of any explosion craters.--Auth.

3-1273. Byers, Frank M., Jr. PETROLOGY OF THREE VOLCANIC SUITES, UMNAK AND BOGOSLOF ISLANDS, ALEUTIAN ISLANDS, ALASKA: Geol. Soc. America, Bull., v. 72, no. 1, p. 93-128, 13 figs. incl. map, diags., pl., 7 tables, Jan. 1961, 92 refs.

This paper tentatively relates the comparative petrology and chemistry of 3 volcanic suites on Umnak and Bogoslof islands in the eastern part of the Aleutian Island arc to tectonic position with respect to the axis of the arc.

Umnak is a large geologically complex island on the Aleutian ridge; Bogoslof, 22 mi. N. of Umnak, is the top of a Recent, largely submarine volcano that rises about 5,000 ft. from the floor of the Bering Sea basin. Southwestern Umnak is underlain by a pre-Quaternary basement of low-grade metamorphic rocks and post-Oligocene mediosilicic plutonic rocks, which are overlain by 2 Quaternary andesitic stratovolcanoes. Northeastern Umnak is underlain by a late Tertiary(?) and Quaternary basaltic shield volcano with a large central caldera. The lavas exposed at Bogoslof in 1947 consisted largely of historically dated volcanic domes ranging in composition from hornblende andesite to hornblende basalt.

Fractional crystallization was probably the dominant process in the formation of quantitatively minor andesite and rhyolite masses associated with the basaltic shield volcano of northeastern Umnak. An extensive blanket of welded andesitic agglomerate and subordinate rhyodacite ash associated with the caldera-forming eruption of the basaltic shield volcano probably owes its composition to a combination of processes, including fractional crystallization, mixing with remelted basalt wall rock, and possibly assimilation of sialic rock.

Most volcanic rocks of southwestern Umnak are similar in composition to the underlying plutonic rocks now exposed. The relatively high Cr and Ni in the southwestern Umnak quartz diorite and in its extrusive equivalent, the hypersthene-bearing labra-

dorite andesite, indicate that these rocks probably did not originate from fractional crystallization of less siliceous rock. The presence of hypersthene in the andesites of southwestern Umnak is probably related to their high Al content ultimately derived by assimilation of aluminous sedimentary rocks. A similar origin is postulated for the hypersthene in the High Cascade lavas.

The slightly alkalic lavas of Bogoslof, typified by hornblende, became progressively less siliceous from 1796 to 1927, but the magmatic diversification in the underlying chamber may have been well advanced prior to 1796.

The petrochemical differences in the 3 volcanic suites of Umnak and Bogoslof are probably related to tectonic position with respect to the Aleutian ridge. The hypersthenic Al-rich lavas of southwestern Umnak were probably generated at relatively shallow depth from preexisting plutonic rocks of similar composition. The position of the andesitic volcanoes on a high-standing, possibly upwarped erosion surface is in accord with Benioff's proposal that the maximum heat would be generated in the crust at the zone of maximum bending across a volcanic arc. The dominantly tensional features associated with the basaltic shield volcano on northeastern Umnak are in accord with its position on the N. flank or inner side of the arc, where a zone of tension may prevail. The slightly alkalic rocks of Bogoslof Island are derived possibly from a tension fracture normal to the arc in the Bering Sea basin.--Auth.

3-1274. Tilley, C.E., and J.H. Scoon. DIFFERENTIATION OF HAWAIIAN BASALTS: TRENDS OF MAUNA LOA AND KILAUEA HISTORIC MAGMA: Am. Jour. Sci., v. 259, no. 1, p. 60-68, 4 figs., 4 tables, Jan. 1961, 8 refs.

New analyses strengthen the conclusion that the historic lavas of Mauna Loa and Kilauea are derived from different magmatic batches. The presence or absence of hypersthene in the lavas seems to be related to the silica and lime contents.--Auth.

3-1275. Matson, Robert E. PETROGRAPHY AND PETROLOGY OF SMOKY BUTTE INTRUSIVES, GARFIELD COUNTY, MONTANA: U.S. Geol. Survey, Repts., Open-File Ser., no. 594, 74 p., 11 illus., 4 maps (1 in pocket, scale 1:250,000), 4 tables, 1960, 32 refs.

The Smoky Butte intrusives are located in T.18 N., R. 36 E. Garfield County, Montana, on the extreme eastern edge of the petrographic province of central Montana. They consist of dikes and plugs arranged in linear, en echelon pattern with a NE. trend and intrude the Tullock member (Paleocene) of the Fort Union formation. Extrusive rocks are absent.

The rocks are K-rich volcanic types showing a disequilibrium mineral assemblage consisting of sanidine, leucite, biotite, olivine, pyroxene, magnetite plus ilmenite, apatite, calcite, quartz, and a yellowish to dark greenish glassy groundmass. Two chemical analyses of Smoky Butte rocks show high Mg, K, Ti, and P, and low Al and Na content. The 2 norm calculations show that the rocks are oversaturated with 1.3 and 3.1% excess silica. Because of the peculiar nature of the Smoky Butte rocks, descriptive names have been applied to them. They are divided into 6 different types.

Three periods of intrusion are proposed for Smoky Butte quarry where 3 rock types crop out. Other evidence for multiple injection occurs in several multiple dikes. The upper contact of the intrusion is visible on a few plugs and dikes.

Smoky Butte rocks show some similarities to the undersaturated K-rich rocks of the Highwood and Bearpaw mountains of Montana, the rocks of the Leucite Hills of Wyoming, and the oversaturated rocks of the West Kimberly district of Australia.--Auth.

3-1276. Kostyuk, V.P. THE PROBLEM OF MIOCENE (PRE-PANNONIAN) VOLCANISM OF TRANS-CARPATHIA: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 48-62, 2 maps, table, pub. 1960, 56 refs.

A brief review of Miocene volcanism in the Transcarpathian foredeep. An attempt is made to establish a general relation between it and the larger province of the inner Carpathians. This relationship enables the author to suggest a stratigraphic position for some of the more important and controversial (as to their age) volcanic beds of the Transcarpathia. A precise determination of the age of terrigenous sedimentary deposits which enclose them is not always possible, because of the paucity of faunal data.--Auth.

3-1277. Kiryushina, M.T. EVIDENCE OF MESOZOIC-CENOZOIC VOLCANISM ON THE NORTHERN EDGE OF THE SIBERIAN PLATFORM: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 37-41, 2 illus., map, 2 tables, pub. 1960, 6 refs.

Volcanic rocks near mid-stream of the Popigay river (right tributary of the Khatanga river) on the northern outskirts of the Siberian platform are described. Fossils date these rocks as Jurassic. Volcanic activity took place much later, even as late as Tertiary. These rocks are more acid than analogous rocks of the Permian-Triassic, and are mainly concentrated in the Popigay graben, a volcano-tectonic depression. Eruptions occurred in the western part of the depression during Meso-Cenozoic times.--From LC.

3-1278. Wager, L.R. THE RELATIONSHIP BETWEEN THE FRACTIONATION STAGE OF BASALT MAGMA AND THE TEMPERATURE OF THE BEGINNING OF ITS CRYSTALLIZATION: Geochim. et Cosmochim. Acta, v. 20, no. 2, p. 158-160, 2 diags., Oct. 1960, 4 refs.

Two chemical indices of crystal fractionations of a magma are the albite/albite + anorthite ratio and the Fe^{+2} + Mn/Mg + Fe^{+2} + Mn ratio. These are compared with experimental melting point data of Yoder and Tilley for 5 basalts. The order of temperature required to produce complete melting was the same as the order of the fractionation stages deduced from the chemical analyses. While the range required to produce melting of the various basalts was small, the differences have a significant effect in the crystallization sequence and the composition of basaltic magmas.--F. Manheim.

3-1279. Lazko, E.M. RECRYSTALLIZATION DURING THE FORMATION OF CRYSTALLINE QUARTZ VEINS. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 2, p. 114-118, Feb. 1961, 12 refs.

Recrystallization plays a large part at all stages of formation of different quartz veins, particularly

crystalline ones. The veins contained in quartzites and other monomineral quartz rocks commonly originate from recrystallization when solutions infiltrate tectonically disrupted zones. In other cases, massive quartz veins have recrystallized with the formation of mixed, polelike aggregates or glassy types of quartz. Recrystallization druses are sometimes formed during the later stages of veining. These can be divided into druses of the first type, formed in the host rock through quartz veins, and those of the second type, formed by collective recrystallization in the host rock.--Auth.

3-1280. Hiss, W.L., and Hugh E. Hunter. MAGNETITE-PYROXENE TEXTURES IN BASIC ROCKS FROM THE WICHITA MOUNTAINS: Oklahoma Geology Notes, v. 20, no. 10, p. 254-255, 4 illus., Oct. 1960, 5 refs.

Precambrian or Early Cambrian basic rocks crop out in the core of the Wichita Mountains igneous complex. Magnetite and clinopyroxene occur throughout the layered series in interstices among subhedral plagioclase laths. Pyroxene texture ranges from subophitic, where small, wedge-shaped grains lie between plagioclase laths, to ophitic where numerous plagioclase grains are enclosed in a single pyroxene grain. Pyroxene crystals range from 0.5 to 50 cm. in diameter. Magnetite crystals range from small, wedge-shaped grains between plagioclase grains to skeletal crystals 20 cm. in diameter enclosing laths of plagioclase. Pyroxene and magnetite appear to have crystallized from pore fluid in a mesh of plagioclase crystals. The remarkable size of the pyroxene and lack of zoning in accompanying plagioclase suggest slow crystallization under conditions closely approaching equilibrium between crystals and melt. --H.E. Hunter.

3-1281. Merritt, C.A. PETROGRAPHY OF THE SPAVINAW GRANITE: Oklahoma Geology Notes, v. 20, no. 9, p. 224-228, 2 illus., map, table, Sept. 1960, 5 refs.

The Precambrian Spavinaw granite in NE. Oklahoma is a medium- to coarse-grained hornblende granite composed of 22% quartz, 37% microperthite and orthoclase, 26% oligoclase, 8% hornblende and chlorite, 4% magnetite and ilmenite, 2% epidote, and 1% apatite. Micropegmatitic rims around the plagioclase grains are a striking microscopic feature. A chemical analysis of the rock and the computed C.I.P.W. norms are included. The silica content is 66.44%.--Auth.

3-1282. Smolin, P.P. MICACEOUS PEGMATITES AND THE ABSOLUTE AGE OF POST-JURASSIC INTRUSIONS IN THE ALDAN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 33-36, illus., map, table, pub. 1960, 9 refs.

Pegmatites, hitherto unknown among younger intrusives of the Aldan, are described, with data on the absolute-age determination by the K-Ar method. Geologic observations suggest an Upper Jurassic age for most of this magmatic complex.--Auth.

3-1283. Yudin, M.I. DUNITES OF THE BORUS RANGE AND THEIR ORIGIN: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 47-62, 12 figs. incl. illus., map, diag., table, pub. 1960, 23 refs.

Dunite and associated pyroxenite are younger than serpentinized ultrabasics of the Borus massif [western Sayan]. They are qualitatively different products of 2 interconnected stages of the same metasomatic process, each representing a change in the quantitative ratios of reactive components MgO and SiO_2 at different depths of the rock being replaced.

Products of the first metasomatic stage - simple and folded pyroxenite veins - have been formed in a chemical reaction between Mg-rich rocks with siliceous solutions ascending along fractures. These siliceous solutions originated as an unavoidable result of the leaching of excess silica at depth, where essentially olivine rocks - dunite - were formed as a result of an influx of Mg.

Replacement was highly selective in both metasomatic stages. Pyroxene veins, which originated at a given horizon, prior to the advent of dunite, were only partly replaced by the dunite, as the main replacement front advanced.

Ptygmatic textures at the albite-epidote-chlorite gneiss contacts suggests a replacement of already folded rocks. Thus, dunite and pyroxenite must have been formed either after the main folding phase or else during its terminal stages.--Auth. summ.

3-1284. Serebryakov, V.A. AUTOMETASOMATIC ALTERATION OF GRANITOIDS AND ASSOCIATION OF TIN MINERALIZATION WITH THE ZONE OF SODIUM-POTASSIUM METASOMATISM. Translated by Eugene A. Alexandrov: Internat. Geology Rev., v. 3, no. 2, p. 100-113, 7 illus., diag., table, Feb. 1961, 8 refs.

Different forms of high-temperature alkaline autometasomatism in granitoids of certain Sn-bearing massifs in the upper course basin of the Kolyma river are considered. The relative depths of massif development have been established from the degree of erosional shearing, higher in massifs enclosed in anticlinal structures.

In massifs developed at the greatest depth the reciprocal replacement of feldspars is accompanied by the destruction of the crystalline lattice of the replaced mineral. In plagioclase formed in place of K-Na-feldspar, myrmekite intergrowths are common; their amount and even their appearance depend chiefly on the degree of difference between the crystalline lattice orientation of the replaced and replacing feldspars.

As the depth of massif development in granitoids decreases, metasomatic replacement with preservation of the replaced feldspar crystalline lattice becomes more frequent in massifs of the least depth of development; such a kind of alkaline autometasomatism is most widespread.

In granitoid massifs of all depths, the formation of metasomatic K-Na-feldspar occurs before the development of metasomatic acid plagioclase varieties. From this it becomes possible to establish 2 stages of alkaline autometasomatism, an earlier K and later Na stage.

In chessboard plagioclases twins develop according to the (010) law with rhombic section as twinning seam; they intergrow also along the (010)-plane, the perpendicular raised to the latter almost coinciding with (010) and making the impression of albite twinning. In chessboard albites the (001)-law is common (twinning seam (010), with an additional intergrowth along the rhombic section, the perpendicular raised to the latter showing several degrees of deviation from (001)).

All of the Sn showings associated with the massifs

under consideration spatially coincide with the rock zone where the feldspar replacement takes place with the crystalline lattices preserved. Therefore, in massifs of the greatest depths of development the Sn showings are located at the exocontacts, and as the depth of development decreases they move towards the central parts of the massifs.--Auth. English summ.

3-1285. Pavlenko, A.S. METASOMATIC FEATURES IN A DISTRICT OF THE KRIVOY ROG REGION: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 63-79, illus., table, pub. 1960, 18 refs.

All metasomatic formations of the area originated as a result of a single hydrothermal-metasomatic process, in the framework of a single structural-tectonic plan. All metasomatic minerals, including the accessory, originated from the components of source rocks, with their composition and relationship determined by the composition of these source rocks and by the differential mobility of components in the metasomatic process. Na is the only component brought in by hydrothermal solutions.

Both the infiltrational and diffusion-metasomatic formations have a zonal structure determined by the sequence of the components' mobility, which is the same in both instances, namely:

K_2O, Na_2O, CaO, MgO, FeO, Fe_2O_3, P_2O_5, TiO_2, ZrO_2, SiO_2, Al_2O_3.

It appears that the composition of all original hydrothermal solutions was carbonate-Na, which would explain the formation of all the observed metasomatic minerals.

A concentration of secondary and scattered elements (TiO_2, P_2O_5, ZrO_2) is possible only in an infiltrational-metasomatic process with the presence of these components in the original rock as a prerequisite.--Auth. summ.

3-1286. Zheru, M.I. RUBY SPINEL OF THE PEREVAL DEPOSIT, AND ITS SECONDARY ALTERATIONS: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 90-96, 4 illus., pub. 1960, 10 refs.

Ruby spinel occurs along with blue spinel in the strongly metamorphosed rocks of the southern Cis-Baikal region. Study of spinel from the Pereval marble deposit has determined the properties of this mineral and of its alteration products, an important step in understanding metamorphic evolution of spinel-bearing marble. The Pereval deposit, 7 km. from Slyudyanka, consists of beds and lenses of Archean carbonate rocks. The entire marble sequence has been cut by sills, dikes, and veins of gabbro-diabase and pegmatites of a Precambrian magmatic cycle. Ruby spinel in the deposit area has been found in forsterite and dolomite-calcite marble, unrelated to pegmatite bodies.

The Pereval spinel-bearing marbles have undergone a number of alterations. Four types of spinel replacement have been identified: diopsidization, phlogopitization, carbonatization, and chloritization. Each of these types is described. Chloritization of spinel completes the deep-seated metamorphic cycle for this mineral. Under subsequent hypergenetic conditions, spinel displays exceptional stability.--A.C. Sangree.

3-1287. Wheeler, E.P., 2d. ANORTHOSITE-ADAMELLITE COMPLEX OF NAIN, LABRADOR: Geol. Soc. America, Bull., v. 71, no. 12, pt. 1, p. 1755-1762, fold. map, table, Dec. 1960, 12 refs.

The anorthosite-adamellite complex has invaded basement-complex gneisses which have a low Na_2O/K_2O ratio and show many features of the granulite facies. Ultramafic rocks of the Alpine type occur. Assignment of the metamorphic rocks to the Grenville province is at least open to question. The anorthositic rocks are subdivided into 3 facies. A dark facies is characterized by dark plagioclase and olivine. A pale facies is characterized by pale plagioclase and a low content of hypersthene with thin exsolution lamellae. A buff-weathering facies is characterized by antiperthitic inclusions in plagioclase, more abundant pyroxenes with exsolution lamellae indicating inversion from pigeonite, and accessory quartz. There is an imperfect progression from the dark facies in the N. and E. through a central area of pale facies to the buff-weathering facies in the S. and W. Adamellite margins are variable in character near anorthosite and in places show clearly intrusive relations. A short distance within the margin a fayalite facies appears. In it plagioclase and pyroxenes resemble those minerals in buff-weathering anorthosite. It is greenish gray when fresh but rusts readily. The fayalite facies is succeeded westward by a hornblende facies in which much of the hornblende is poikilitic. There is also a biotite facies with intrusive relations toward the fayalite facies. Possibly it is more abundant toward the W. margin of the complex. Small intrusive bodies occur, in many cases in gneiss zones involved with the anorthosite-adamellite complex. Many of them show affinities with the adamellitic rocks. Some olivine gabbroic rocks may be related to the anorthosite. Variations in composition of rocks and minerals of the complex could result from repeated intrusion of magmatic material evolving through differentiation by partial crystallization, with the zone of intrusion migrating westward. Faulting occurred in the region, but field data are insufficient for evaluation.--Auth.

3-1288. Larsen, Leonard H., and Arie Poldervaart. PETROLOGIC STUDY OF BALD ROCK BATHOLITH, NEAR BIDWELL BAR, CALIFORNIA: Geol. Soc. America, Bull., v. 72, no. 1, p. 69-91, 10 figs. incl. 2 maps, diags., pl., 9 tables, Jan. 1961, 32 refs.

Compton made a detailed study of the Bald Rock batholith, California, and suggested that the tonalites and granodiorites of the rim of the batholith originated through contamination. He believed that trondhjemite magma, represented by rocks in the core of the batholith, assimilated metabasaltic country rocks. This paper reports a detailed study of 22 rocks from the batholith, including all the main rock types. Values for Qu, Or, Ab, and An calculated from the modes show that the rocks fall along a trend slightly below the cotectic boundary between quartz and feldspars and directed toward this surface. Compositions calculated from the modes indicate that formation of the tonalites by contamination is possible but requires improbably high proportions of metabasalt xenoliths in the rim of the pluton. Habits of zircons separated from the rocks show a distribution pattern which emphasizes contrasts between trondhjemitic core and granodiorite-tonalite rim of the batholith but does not support the idea of formation of the mantle rocks by contamination. Dimensional zircon data indicate that zircons of the core are unimodal, whereas those of the mantle of the batholith are bimo-

dal. Comparisons with the Bald Mountain batholith, Oregon, demonstrate many similarities, as well as some striking contrasts. Compositional trends of tonalite to granodiorite are different for the 2 plutons. Zircons are the same throughout the Bald Mountain batholith. The writers conclude that both plutons were emplaced by forceful injection. At Bald Mountain, Oregon, a uniform magma was injected, but at Bald Rock, California, a migma-magma was emplaced. The trondhjemitic core of the Bald Rock batholith was mainly liquid at emplacement, but the tonalite-granodiorite rim consisted of mobile, viscous solid phases with interstitial melt. The liquid line of descent at Bald Mountain, Oregon, was from tonalite to granodiorite and at Bald Rock, California, only from trondhjemite to leucotrondhjemite.--Auth.

3-1289. Afanasev, G.D., and A.M. Borsuk. NEW DATA ON POST-JURASSIC MAGMATISM OF NORTHWESTERN CAUCASUS: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 20-34, 6 illus., map, 3 tables, pub. 1960, 21 refs.

This paper presents petrographic descriptions and geologic data on the western terminal of the main range of the northwestern Caucasus and cites evidence of specific cases of magmatism, chiefly Cenozoic. Four main rock types are described: 1) high-alkaline gabbroids of the essexite type; 2) eruptive breccias making up bodies of the explosive vent type; 3) eruptive breccias of Semashkho mountain with high-alkalinity suggesting kinship with the Krivenkov subintrusive granitoid body; and 4) watershed-type breccia with abundant K-rich trachytoids of the bostonite type over a basement of altered trachytic tuff and clay. Zeolite rocks tending to alkaline-type associations are rare in the northern Caucasus proper. The data point to a diversified series of basic rocks of different ages, developed within the axial zone of the northern Caucasus and generally associated with Jurassic volcanism.--A. Eustus.

3-1290. Domarev, V.S., and E.B. Vysokoostrovskaya. NEAR SURFACE INTRUSIONS AND THE AGE OF THE UYMENSK DEPRESSION GRANITOIDS (GORNYY ALTAY): Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 35-46, map, diag., table, pub. 1960, 10 refs.

This paper deals with the Uymen depression granitoids belonging to 2 intrusions [probably post-Devonian] of different ages, each of whose component rocks has different geologic, petrographic, and, to a certain extent, geochemical properties. The character of the associated ore mineralization of each type is also different. The younger intrusion is represented by near-surface granite porphyry, the older, by coarse-grained biotite and biotite-hornblende granite, components of large massifs.--Auth.

10. SEDIMENTARY PETROLOGY

See also: Areal and Regional Geology 3-1068; Stratigraphy 3-1143; Geochemistry 3-1250, 3-1251, 3-1252; Mineralogy 3-1258, 3-1259, 3-1260, 3-1266, 3-1267, 3-1271; Engineering Geology 3-1368.

3-1291. Zeigler, John M., and others. WOODS HOLE RAPID SEDIMENT ANALYZER: Jour. Sed. Petrology, v. 30, no. 3, p. 490-495, 2 illus., diag., graph, table, Sept. 1960, 9 refs.

A recording rapid sediment analyzer has been developed at the Woods Hole Oceanographic Institution from the method and technique described by Appel. The system measures pressure changes induced in a column of water by sediment settling through a measured distance. Mechanical analysis of sediment samples whose sizes are between coarse silts and fine gravels can be made. The authors estimate that one operator could complete curves for a maximum of 150 sand samples in a day.

Reproducibility of results is excellent. In some of the tests there was no variation of the standard deviation around an average particle diameter, at least to the fourth decimal place. A comparison of mechanical analysis by sieving and settling is given, and a method for determining shape is described.--Auth.

3-1292. Scull, Berton J. REMOVAL OF HEAVY LIQUID SEPARATES FROM GLASS CENTRIFUGE TUBES - ALTERNATE METHOD: Jour. Sed. Petrology, v. 30, no. 4, p. 626, Dec. 1960, ref.

Suggests using liquid N instead of dry ice as described by Fessenden (GeoScience Abstracts 2-700).--D. Carroll.

3-1293. Spencer, Charles W. METHOD FOR MOUNTING SILT-SIZE HEAVY MINERALS FOR IDENTIFICATION BY LIQUID IMMERSION: Jour. Sed. Petrology, v. 30, no. 3, p. 498-500, Sept. 1960.

Describes mounting mineral grains in flexible collodion so that refractive may be determined by successive use of several liquids.--D. Carroll.

3-1294. Sarin, Dev D. MOUNTING HEAVY MINERAL GRAINS: Jour. Sed. Petrology, v. 30, no. 4, p. 619, Dec. 1960.

Describes a method of mounting mineral grains in uncooked Canada balsam, covering with a glass slip, and warming in an oven at 65 to 70°C. for 6 to 8 hours.--D. Carroll.

3-1295. Young, L.M., and C.J. Mankin. IMPREGNATION OF SANDS WITH "BIO-PLASTIC" FOR GRAIN ORIENTATION STUDIES: Oklahoma Geology Notes, v. 20, no. 10, p. 266-267, Oct. 1960, 2 refs.

A procedure for in situ lithification of sediments with "Bio-Plastic" has been developed with particular reference to studies of river deposits. Comparison with 2 other similar materials shows that the "Bio-Plastic" sets faster, is easier to handle, and is more readily available. A step-by-step procedure is given for the lithification of fluvial sands.--C.J. Mankin.

3-1296. Shumway, George, and Kim Igelman. COMPUTED SEDIMENT GRAIN SURFACE AREAS: Jour. Sed. Petrology, v. 30, no. 3, p. 486-489, 2 graphs, Sept. 1960, 6 refs.

Approximate sediment grain surface areas were computed for 109 natural sediment samples ranging from sands to clays. This was done by assuming all particles to be spherical and summing the areas for

each size fraction in the grain size analysis, where the average diameter for the size fraction was used for all grains in the fraction. The data are presented both as area per unit mass of dry sediment and as area per unit volume of wet sediment. Comparison of the results with theoretical curves for uniform spheres indicates the useful range of these computations.--Auth.

3-1297. Wolf, Karl H., and S. St. J. Warne. REMARKS ON THE APPLICATION OF FRIEDMAN'S STAINING METHODS: Jour. Sed. Petrology, v. 30, no. 3, p. 496-497, Sept. 1960.

Successful applications of the tests described by Friedman (GeoScience Abstracts 1-1250) on a wide variety of materials containing calcite, aragonite, dolomite, and gypsum from recent and ancient sediments are reported.--D. Carroll.

3-1298. Pettijohn, F.J. THE TERM GRAYWACKE: Jour. Sed. Petrology, v. 30, no. 4, p. 627, Dec. 1960, 10 refs.

Comments on Boswell's note (GeoScience Abstracts 2-1773) on graywackes and draws attention to recent studies of rocks from the original type areas in the Harz Mountains, Germany.--D. Carroll.

3-1299. Trefethen, Joseph M., and Robert L. Dow. SOME FEATURES OF MODERN BEACH SEDIMENTS: Jour. Sed. Petrology, v. 30, no. 4, p. 589-602, 22 illus., Dec. 1960, 4 refs.

Studies of selected tidal flats on the Maine coast give opportunity to observe a variety of sedimentary features in the making. Varieties of ripple mark, rill mark, grain size distribution, beach chutes with "flow" marks, mounds, mud pebbles, and primary lineation are figured and briefly discussed.--Auth.

3-1300. Wolf, Karl H. COMMENTS ON "SMALL SCALE CROSS-LAMINATION IN LIMESTONES": Jour. Sed. Petrology, v. 30, no. 3, p. 497-498, Sept. 1960, 5 refs.

Discusses the difficulties in interpreting cross lamination in limestones (GeoScience Abstracts 1-1257) in the light of present day occurrences in shallow waters.--D. Carroll.

3-1301. Tanner, William F. SHALLOW WATER RIPPLE MARK VARIETIES: Jour. Sed. Petrology, v. 30, no. 3, p. 481-485, 4 figs. incl. illus., map, Sept. 1960, 13 refs.

Eight distinctive but little-known ripple mark varieties have been recognized in shallow water (less than 1 m. deep) along the Florida panhandle coast. Three additional well-known varieties have been seen in water up to 20 m. deep. The shallow-water varieties are thought to be caused by falling water level, direct wind effects, or a combination of 2 or more wave sets. One of these varieties, a symmetrical ripple mark, is shown to deviate in plan by as much as nearly 45° from the waves which produce it. Since this latter type is difficult to identify, its lithified counterparts might be easily misinterpreted.--Auth.

3-1302. Sheppard, Richard A., and Ralph E. Hunter. CHAMOSITE OOLITES IN THE DEVONIAN OF PENNSYLVANIA: Jour. Sed. Petrology, v. 30, no. 4, p. 585-588, 2 illus., Dec. 1960, 8 refs.

Previously described "sporelike fossils" in a black silty shale in the Devonian Montebello sandstone, N. of Harrisburg, Pennsylvania, were restudied and found to be flattened chamosite oölites. The environment in which the oölites formed was marine, slightly reducing, having a small clastic influx, and with currents strong enough to agitate sand grains.--Auth.

3-1303. Rusnak, Gene A. SOME OBSERVATIONS OF RECENT OOLITES: Jour. Sed. Petrology, v. 30, no. 3, p. 471-480, 4 illus., 2 maps, graphs, table, Sept. 1960, 17 refs.

Oölite grains and oölitic sands are described from a newly recognized depositional area along the Texas Gulf Coast. These deposits occur in the high salinity lagoon environment of the Laguna Madre. They are associated with the wave-exposed shorelines characterized by low rates of terrigenous sedimentation, high salinities, high summer temperatures, and active carbonate deposition. The descriptive details presented include comparison with the oölite grains and oölitic sands from the Great Salt Lake and the Bahamas. Special reference is made to the radial, tangential, and unoriented crystallites within the oölitic layers from these separate localities. It is concluded that the Laguna Madre oölites are forming on the wave-exposed shoreline by insolation, evaporation, and agitation of carbonate saturated waters. The internal arrangement of the individual aragonite crystallites within the oölitic layers seems dependent upon the rate of carbonate precipitation and the degree of mechanical reorientation by grain to grain rubbing.--Auth.

3-1304. Hsu, K. Jinghwa. TEXTURE AND MINERALOGY OF THE RECENT SANDS OF THE GULF COAST: Jour. Sed. Petrology, v. 30, no. 3, p. 380-403, 5 maps, chart, 7 diags., 2 graphs, 16 tables, Sept. 1960, 16 refs.

The objectives of this investigation are to determine the major transportation paths for the Recent beach sands of the Gulf of Mexico and to relate the textures and mineralogy of the Recent sands to their depositional environments.

Approximately 200 Recent sand samples were collected from the rivers and beaches of the Gulf Coast states. Mechanical analyses were made to determine the grain size and sorting. Spectrochemical methods were used to determine chemical composition, and thin-section Rosiwal analyses were used to determine mineralogical composition.

The major conclusions of this investigation are as follows: 1) The Recent beach sands E. of the Mississippi River delta are mature quartz sands which contain practically no feldspar and a mature heavy-mineral suite rich in staurolite and kyanite. The Recent beach sands W. of the Mississippi River are feldspathic. The feldspar abundance of these sands decreases from the Mississippi delta area westward in the direction of prevailing longshore currents, mainly by dilution. The heavy-mineral suite of the Recent beach sands from Louisiana and E. Texas contains abundant unstable minerals; among the resistant heavy minerals, garnet predominates over staurolite and kyanite.

2) The relative abundance of unstable heavy minerals which can easily be decomposed during weathering or by postdepositional changes is not a reliable

criterion for paleogeographic interpretations. On the other hand, feldspar abundance and ratio of garnet to staurolite plus kyanite, can be used to recognize ancient petrologic provinces.--Auth.

3-1305. McMaster, Robert L. MINERALOGY AS AN INDICATOR OF BEACH SAND MOVEMENT ALONG THE RHODE ISLAND SHORE: Jour. Sed. Petrology, v. 30, no. 3, p. 404-413, 2 maps, graph, 9 tables, Sept. 1960, 10 refs.

Southwestern Rhode Island beach sands are composed of a great variety of minerals, the most common of which are amphiboles, chlorite, garnet, staurolite, and black opaques in the heavy fraction and feldspars and quartz in the light fraction. Counts of these fractions from samples collected at 1-mi. intervals were used as basic data for multivariate and trend analyses. Character of source materials and pattern of beach drift are believed responsible for areal differences in mineral composition. Distribution of certain selected minerals indicates that major sand movement trends are convergent toward the center section of this stretch of beaches.--Auth.

3-1306. Greensmith, John Trevor. UPPER CARBONIFEROUS SEDIMENTATION IN DERBYSHIRE: Jour. Sed. Petrology, v. 30, no. 4, p. 628, Dec. 1960, 4 refs.

The author comments on the concept of the mode of deposition of the Mam Tor sandstones, Derbyshire, England, evolved by Allen (GeoScience Abstracts 2-3052), and notes that a similar pattern of sedimentation, although with significant differences, is present at higher Naumurian horizons within the same general area. The essential difference at these higher stratigraphic levels is the general absence of a sharp lithologic break between the shales and the immediately overlying sandstone.--L.M. Dane.

3-1307. Hamilton, Edwin L. OCEAN BASIN AGES AND AMOUNTS OF ORIGINAL SEDIMENTS: Jour. Sed. Petrology, v. 30, no. 3, p. 370-379, sec., diag., 6 tables, Sept. 1960, 26 refs.

The present sediment thicknesses in deep-sea basins, away from continents and islands, are apt to be the total thicknesses of the first 2 (or more) layers revealed by seismic surveys. The application of soil mechanics techniques to this and associated problems indicates the possibility of determining approximate amounts of original sediments necessary to consolidate and lithify into present thicknesses. Once this is done, then computations can be made of the amounts of solids in the original sediments, and, assuming rates of sedimentation, estimates can be made of the ages of ocean basins under specific localities. In general, these computations and estimates indicate sufficient solids are present on the sea floor to satisfy the needs of the world-wide geochemical balance and that the ocean basins are of ancient age (Paleozoic to pre-Paleozoic).--Auth.

3-1308. Heald, Milton T., and Ralph C. Anderegg. DIFFERENTIAL CEMENTATION IN THE TUSCARORA SANDSTONE: Jour. Sed. Petrology, v. 30, no. 4, p. 568-577, 9 illus., 3 figs., Dec. 1960, 4 refs.

The Tuscarora sandstone is generally tightly cemented with secondary quartz, but locally the cement is irregularly distributed. Some beds have a banded appearance caused by alternating layers of tightly cemented and poorly cemented zones. Argillaceous material occurs in the poorly cemented bands and apparently inhibited the development of normal secondary growths. A lattice pattern results where cemented bands formed at right angles to bedding as well as parallel to bedding. The transverse bands may have been controlled by fractures inasmuch as they are parallel to fractures in the formation. Uncemented lenses occur in some beds which are otherwise tightly cemented. Gas pockets apparently prevented complete cementation in these bed. Considerable primary clay was replaced by secondary quartz because clay is present in the uncemented lenses but is lacking in the cemented rock enclosing the lenses. Thick clay coatings on grains may prevent growth of secondary quartz. If pressure solution does not occur, considerable porosity is present where the grains are coated with clay.--Auth.

3-1309. Adams, John Emery, and Mary Louise Rhodes. DOLOMITIZATION BY SEEPAGE REFLUXION: Am. Assoc. Petroleum Geologists, Bull., v. 44, no. 12, p. 1912-1920, 2 secs., 2 diags., Dec. 1960, 15 refs.

Bedded dolomites in the Permian basin were formed by the alteration of metastable limestones by hypersaline brines refluxing from evaporite lagoons. The hot, heavy, highly alkaline, carbon dioxide-free, Mg-supercharged brines displaced connate waters to provide both a chemically favorable environment for Mg-Ca exchange and a vehicle for removing displaced Ca. Fossil lagoonal brines and fillings of halite and andydrite in the dolomite pores offer proof of the brine invasion. Sedimentary dolomites in other areas are commonly associated with evaporites, and for these dolomites a similar origin is postulated. --Auth.

3-1310. Emrich, Grover H. CROSS-BEDDING AND TEXTURAL VARIATIONS OF THE MIOCENE HAWTHORNE FORMATION IN NORTHERN FLORIDA: Jour. Sed. Petrology, v. 30, no. 4, p. 561-567, 5 maps, graph, Dec. 1960, 16 refs.

The Miocene Hawthorne formation of northern Florida and southwestern Georgia consists principally of unconsolidated sands and thin beds of clay. It was studied to investigate the relationship between direction of cross-bedding and textural variations. From 24 outcrops 284 cross-bedding measurements were obtained and 50 size analyses were made.

In contrast to many other studies, cross-bedding of the Hawthorne formation was found to be extremely variable but, nevertheless, indicating a southerly direction of transport with large local deviations. Toward the S. the sands generally become coarser and have their poorest sorting. Relationships between sorting and the median diameter of the sands were not as clearly defined as in other studies.

Several possibilities are suggested to explain the anomalies in direction of transport and variation of texture.--Auth.

3-1311. Cazeau, Charles J. CROSS-BEDDING DIRECTIONS IN UPPER TRIASSIC SANDSTONES OF WEST TEXAS: Jour. Sed. Petrology, v. 30, no. 3, p. 459-465, 3 maps, diag., graph, Sept. 1960, 20 refs.

Upper Triassic nonmarine sandstones and shales

of the Dockum group occupy a widespread area in W. Texas. The source area(s) for these beds has been a subject of varied opinion. Dip directions of foreset beds within the commonly cross-bedded sandstones were studied at 108 outcrops scattered throughout 7 counties in order to determine the direction of regional paleocurrents. Results show a predominance of dips to the NW. and W. The inferred source areas lie mainly to the SE. and E. of the depositional area. The Llano uplift region of central Texas, lying to the SE. of the area studied, was a major contributor of sediments during Late Triassic time.--Auth.

3-1312. Farkas, Steven E. CROSS-LAMINATION ANALYSIS IN THE UPPER CAMBRIAN FRANCONIA FORMATION OF WISCONSIN: Jour. Sed. Petrology, v. 30, no. 3, p. 447-458, 10 figs. incl. maps, chart, secs., diags., graphs, table, Sept. 1960, 34 refs.

The type of cross-lamination most commonly observed in the Upper Cambrian Franconia formation of southwestern Wisconsin is trough cross-lamination. Statistical analyses of 1,023 cross-lamination dip azimuths in the sandstone members of the Franconia formation indicate a preferred orientation of sedimentary transport 151° to the SE. The mean dip of the individual cross-laminae in 700 measurements is 18°. A comparison of sand size of individual cross-laminae with degree of dip indicates that an increase in dip is associated with good sorting and coarser grain size.

The Precambrian upland to the N. of the area (or strata in equivalent position) is believed to have supplied sediments to the Franconia seas. Cross-lamination (azimuth) study of the Precambrian Baraboo quartzite within the area also reflects this northerly source. Similar evidence obtained from regional studies of Huronian and Upper Cambrian sediments indicates the possibility of a stable regional paleoslope throughout a substantial period of geologic time.--Auth.

3-1313. Seidov, A.G. PETROGRAPHIC STUDY OF CLAYS FROM MAIKOP FORMATION OF THE AZERBAYDZHAN CIS-CASPIAN OIL PROVINCE: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 2, p. 69-77, 2 illus., 3 graphs, 5 tables, pub. 1960, 5 refs.

Principal rock-forming clay minerals of the Maykop formation from the Cis-Caspian oil province are montmorillonite, and to a lesser extent beidellite and hydromica. Impurities are kaolinite, halloysite, and glauconite. The upper division of the Maykop formation is primarily montmorillonitic; the lower division is montmorillonite and hydromica. Among the syngenetic minerals, pyrite, siderite, and glauconite have been identified.

As a result of dyeing of clays and the determination of pH and Eh, the Maykop section may be subdivided into 2, locally 3, zones of definite assemblages of clay minerals and of different pH and Eh values of their water suspensions.

Oily components predominate the bitumens of the Maykop formation, where they are little or unoxidized. The high organic C content, locally up to 5%, is characteristic.

Lower Maykop deposits are primarily represented by calcareous sedimentary clays. Hydromica clay minerals, especially in the lower part of this division, suggest a normal marine basin of deposition. The presence of pyrite derived from organic matter, the strong carbonatization of the rocks, and the presence in them of scattered ferruginous carbonates (e.g., siderite), suggest a preponderance of reducing conditions, during the early Maykop time. The mineral composition of clays is represented here by montmorillonite and hydromicas.

Upper Maykop deposits are represented by a littoral, arenaceous, argillaceous facies, changing to a clay facies in the SE. The predominance of montmorillonite clay minerals, the lack of carbonates ($CaCO_3$) in clays, along with the presence of pyrite and organic matter, suggest an alkaline, reducing environment.

The Maykop age, especially its first half, had favorable geochemical and lithologic conditions for an adequate accumulation of organic matter and for its subsequent conversion into oil. On the basis of this study, the Maykop formation is best suited among Azerbaijan Tertiary rocks to be a probable source of oil.--Auth. concl.

3-1314. Nitecki, Matthew H. A CARBONATE VEIN IN LIMESTONE: Jour. Sed. Petrology, v. 30, no. 4, p. 624-625, illus., table, Dec. 1960, 2 refs.

A small vein from the Salem limestone [Mississippian] of Indiana was studied in thin section. Spectrographic analyses were made of Foraminifera, limestone with fossils, a clear and an opaque calcite. Cementation may have occurred by dissolution at points of high compressive strength and reprecipitation at points of low stress; or, organically formed calcite may dissolve with stress as it is less stable, because of high MgO-content, than chemically formed calcite.--D. Carroll.

3-1315. Scholl, David W. PLEISTOCENE ALGAL PINNACLES AT SEARLES LAKE, CALIFORNIA: Jour. Sed. Petrology, v. 30, no. 3, p. 414-431, 9 illus., map, secs., 2 tables, Sept. 1960, 29 refs.

Searles Lake is a playa or dry lake which occupies the central floor of Searles basin, a northward-trending graben of the Basin and Range province in southeastern California. During pluvial periods of the Pleistocene epoch, deep-water lakes filled Searles basin, and in 2 of these lakes more than 500 pinnacled masses of calcareous tufa accumulated in an armlike bay at the SW. end of the basin.

Pinnacles are tower-, tombstone-, and cone-shaped masses and large limestone ridges. Most of the pinnacles are 10 to 40 ft. high, but a few reach heights between 100 and 140 ft. Basal diameters or widths range from about 10 ft. to as much as 500 ft. and average 20 to 30 ft. Seven varieties of tufa compose the pinnacles; one of these varieties is also found in lenticular bodies buried in the lacustrine sediments underlying the pinnacles at the northern end of the bay.

It is proposed that the pinnacles were precipitated by algae about the orifices of sublacustrine springs issuing along faults striking N. 65°W., N. 50°W., N. 30°E., N 55°E., and N. 65°E. in the underlying basement rocks. Deposition of the pinnacles at the SW. end of the bay took place in a lake of Tahoe age which filled Searles basin more than 32,000 years ago. Pinnacles midway along and at the northern end of the bay formed in a lake of Tioga age which initially flooded Searles basin about 23,000 years ago and lasted until about 10,000 years ago. Tioga Searles Lake at its maximum stand was approximately 460 ft. deep and at its highest stage the surface reached an elevation of about 2,000 ft.--Auth.

3-1316. Zadnik, Valentine E. PETROGRAPHY OF THE UPPER CAMBRIAN DOLOMITES OF WARREN

COUNTY, NEW JERSEY: U.S. Geol. Survey, Repts., Open-File Ser. no. 596, 96 p., 18 illus., 8 pls. incl. map, [1960], 33 refs.

Petrographic investigation of the Upper Cambrian dolomites along the Delaware River in Warren County has led to the distinction of 6 different microfacies each representing a specific sedimentary environment. In order of decreasing relative depth these microfacies are: dololutite, dolarenite, oölitic dolarenite, dolorudite, cryptozoan dolomite, and desiccation dolorudite.

Over 1,200 samples spaced at an average interval of 1.8 ft. were collected from 2 measured sections, one at Riegelsville, and another at Carpentersville. Thin sections, cut perpendicular to the bedding, were made and analyzed according to the method used by Albert V. Carozzi, which consists of the statistical measurement of the sizes and frequencies of detrital, authigenic, and organic components of a sedimentary rock. In this investigation, 3 general types of parameters were investigated: detrital components, degree of crystallinity, and chemical composition. The detrital components present in sufficient abundance for study are quartz, pyrite, oölites, and reworked lithic fragments. The maximum size of the largest optically continuous dolomite crystals for each thin section was measured to obtain the degree of crystallinity. Chemical composition was investigated by means of an X-ray diffractometer.

The results of the statistical measurement are interpreted by means of a bathymetrical curve showing the variations of relative depth as a function of thickness. The oscillations in the bathymetrical curve exhibit superposed asymmetrical cycles of sedimentation. The ideal cycle begins with structureless dololutite (deepest water facies) and grades upward through progressively shallower facies and terminates with desiccation dolorudite. Immediately overlying this dolorudite is a dololutite which begins the superjacent cycle. The bathymetrical curve also displays a rhythmic occurrence of series of cycles or megacycles. Within each megacycle, each superposed cycle terminates in a progressively shallower microfacies.

The 2 investigated sections do not overlap stratigraphically, and therefore correlation could not be attempted. Although correlation on the basis of individual cycles is probably limited to short distances, the megacycles and the major groups of cycles could provide a valuable means of correlation in this general area.--Auth.

3-1317. Greensmith, John Trevor. INTRODUCTION TO THE PETROLOGY OF THE OIL-SHALE GROUP LIMESTONES OF WEST LOTHIAN AND SOUTHERN FIFESHIRE, SCOTLAND: Jour. Sed. Petrology, v. 30, no. 4, p. 553-560, 4 figs. incl. map, Dec. 1960, 13 refs.

Five distinctive limestone microfacies (oölitic, oölitoid, micro-conglomeratic, shelly, and nodular) are recognized [in the Carboniferous Oil Shale group], each of which may be present within one individual bed. They generally indicate shallow-water, restricted lagoonal conditions inimical to organic life. Sometimes the conditions were modified, allowing organisms such as worms and ostracods to proliferate; rarely, a widespread linkage of adjacent lagoons allowed a more comprehensive fauna to develop. The limestones are invariably associated with shales into which they normally sharply grade.--Auth.

3-1318. Menard, Henry W. CONSOLIDATED SLABS ON THE FLOOR OF THE EASTERN PACIFIC: Deep-Sea Research, v. 7, no. 1, p. 35-41, 3 illus., chart, table, Aug. 1960, 8 refs.

Tabular masses, largely phillipsite coated with manganese oxide, are abundant on the floor of the eastern Pacific. They appear to be remnants of layers of volcanic ash derived in large part from volcanoes within the basin. Some of the ash may correlate with the Worzel ash off Central and South America.--Auth.

3-1319. Lisitzin, A.P. BOTTOM SEDIMENTS OF THE EASTERN ANTARCTIC AND THE SOUTHERN INDIAN OCEAN: Deep-Sea Research, v. 7, no. 2, p. 89-99, 4 charts, Oct. 1960, 8 refs.

During the voyage of the Soviet Marine Antarctic Expedition on the Ob in 1955-1957, much new bottom sediment material was obtained in the Indian Ocean sector of the Antarctic and the southern Indian Ocean. The first cores as long as 16 m. in this general area were taken, as well as many more up to 4 to 5 m. long. Although detailed studies have not yet been completed, it is nevertheless possible to make a preliminary report on the development and properties of the main types of sediments and the rate of sedimentation at present in this part of the Antarctic. There are also some data on the thickness of "iceberg" and diatom sediments.--Auth.

3-1320. Harrison, W. ORIGINAL BEDROCK COMPOSITION OF WISCONSIN TILL IN CENTRAL INDIANA: Jour. Sed. Petrology, v. 30, no. 3, p. 432-446, 2 maps, diag., 2 graphs, 3 tables, Sept. 1960, 36 refs.

An attempt has been made to convert the mineral and rock-fragment components of a till into the original bedrock materials from which they were derived. The till used was a composite one (designated the "typical" till) that represented the averaged fraction-analysis data for 11 highly similar till samples from Marion County, central Indiana. For this study it was assumed that: 1) the glacier flow unit that reached Marion County was 20 mi. wide and coincided with a series of interconnected bedrock lowlands lying between northeastern Indiana and Lake Naococane, Quebec, 2) the flow unit eroded bedrock (or older drift) continuously throughout its journey from Lake Naococane, and 3) the different shales traversed by the ice were eroded equally.

In terms of volume-percent composition, the typical Wisconsin till in Marion County probably consists of about 33% shale, 29% metamorphic and igneous rock, 18% limestone, 16% dolomite, 2% sandstone and siltstone, and 2% miscellaneous rocks. Approximately 90% of the typical till may consist of bedrock from outcrops more than 100 mi. upstream from the site of till deposition.

An approximate 1 to 1 relationship has been found between the weight percent of a given rock type in the typical till and the percent of outcrop area of that rock type upstream. Implications of this relationship are that: 1) the ice streams that developed the Marion County tills eroded materials according to a weight rule, 2) the tills were not deposited by lodgement processes, and 3) the ice streams picked up and transported bedrock for distances in excess of 1,200 mi.--Auth.

3-1321. Crook, Keith A.W. PETROLOGY OF TAMWORTH GROUP, LOWER AND MIDDLE DEVO-

NIAN, TAMWORTH-NUNDLE DISTRICT, NEW SOUTH WALES: Jour. Sed. Petrology, v. 30, no. 3, p. 353-369, 11 illus., map, 3 tables, Sept. 1960, 13 refs.

The Tamworth group is dominantly of deep-water origin and consists largely of graywacke rudites, graywackes, and argillites. The latter usually contain Radiolaria. Lithic labile graywackes are dominant and consist chiefly of andesitic detritus (rock fragments, plagioclase, ferromagnesians, chlorite, and accessories) with minor rhyolitic, granitic, and older sedimentary components. They are thought to have originated in complex island arcs.

Minor feldspathic labile graywacke and argillaceous limestone occurs. The former is thought to be largely of andesitic origin, being redistributed crystal tuff with admixed plutonic quartz. The limestones, small silty lenses, are probably the result of calcification during early diagenesis.

The feldspar in most of the group is now albitized, but relics of andesine-labradorite remain occasionally.

The Drik-Drik formation low in the sequence is largely coarse keratophyric detritus, heavily hematitized and scarcely transported. It may be a shallow-water deposit derived from the underlying Copes Creek keratophyre, or from contemporaneous volcanics on an adjoining land-mass.--Auth.

3-1322. Crook, Keith A.W. PETROLOGY OF PARRY GROUP, UPPER DEVONIAN-LOWER CARBONIFEROUS, TAMWORTH-NUNDLE DISTRICT, NEW SOUTH WALES: Jour. Sed. Petrology, v. 30, no. 4, p. 538-552, 8 illus., 2 diags., 9 tables, Dec. 1960, 10 refs.

The Parry group conformably overlies the Tamworth group in the Tamworth trough sequence of northeastern New South Wales. It consists dominantly of olive-green chloritic mudstones together with lithic labile graywacke and sandstone, feldspathic graywacke, argillaceous and lithographic limestone, and polymictic conglomerate. The detritus is thought to have been derived from an andesitic island arc which contained local exposures of older sediments, granite, and acid volcanics. The lithic labile arenites consist dominantly of volcanic rock fragments and plagioclase, generally albitized but occasionally unaltered andesine, with some clinopyroxene, amphibole, chlorite, opaques, and minor quartz. The modal composition of these rocks shows a restricted range of variation through the sequence, which suggests that changes of composition of source areas were not marked during the period of deposition of the sequence.--Auth.

11. GEOHYDROLOGY

See also: Mineral Deposits 3-1332; Engineering Geology 3-1372.

3-1323. Walton, William C. LEAKY ARTESIAN AQUIFER CONDITIONS IN ILLINOIS: Illinois State Water Survey, Rept. Inv. 39, 27 p., 4 maps, 2 secs., 8 graphs, logs, table, 1960, 12 refs.

Leaky artesian conditions exist in many parts of Illinois where aquifers are overlain by deposits or confining beds which impede or retard the vertical movement of ground water. Under leaky artesian conditions, the cone of depression developed by a pumping well is influenced by the vertical permeability of the confining bed in addition to the hydraulic properties and geohydrologic boundaries of the aquifer.

The vertical permeability of a confining bed often can be determined from the results of pumping tests by using the nonsteady-state leaky artesian aquifer equation derived by Hantush and Jacob. A time-drawdown type curve method for analyzing pumping test data under nonsteady-state conditions is described in detail. A distance-drawdown type curve method for analyzing pumping test data under steady-state conditions devised by Jacob is also described. These 2 methods are applied to available pumping test data for Illinois. The results of a test made near the village of Dieterich in Effingham County are presented to illustrate the analysis of data. A summary of the leaky artesian test data collected to date indicates that the vertical permeability of glacial drift deposits in the southern half of Illinois ranges between 0.08 and 1.6 gallons per day (g.p.d.) per sq. ft.

Effects of leakage closely resemble the effects of a recharge boundary if the effects of partial penetration are excluded. The data for the Dieterich pumping test are used to show that recognition of leaky artesian conditions is critically important in predicting the water supply potential of wells and aquifers.

A form of Darcy's law is applied to data on the piezometric surface of the Cambrian-Ordovician aquifer to determine the order of magnitude of the vertical permeability of the Maquoketa formation [Upper Ordovician]. The Maquoketa formation has a maximum thickness of about 250 ft., consists largely of beds of dolomitic shale, and confines water in the Cambrian-Ordovician aquifer under artesian pressure. The Cambrian-Ordovician aquifer is encountered at an average depth of 500 ft. below the surface at Chicago, has an average thickness of 1,000 ft., consists mainly of beds of sandstone and dolomite, and is the most highly developed source of large ground-water supplies in northeastern Illinois. Computations indicate that the average vertical permeability of the Maquoketa formation in northeastern Illinois is about 0.00005 g.p.d. per sq. ft. Leakage in 1958 through the Maquoketa formation in northeastern Illinois is estimated to be about 8,400,000 g.p.d. or about 11% of the water pumped from deep wells.--Auth.

3-1324. Sugisaki, Ryuichi. MEASUREMENT OF EFFECTIVE FLOW VELOCITY OF GROUND WATER BY MEANS OF DISSOLVED GASES: Am. Jour. Sci., v. 259, no. 2, p. 144-153, 3 maps, graph, 4 tables, Feb. 1961, 10 refs.

Confined ground water is isolated from the air, and its content of dissolved gases is decisively controlled by the temperature of the water when it was exposed to the atmosphere. On account of seasonal variation of the original water temperature, there must be seasonal variation in the dissolved-gas content of ground water. The gas content as influenced by seasonal variation of temperature has been investigated by successive observations of water from a few wells and by simultaneous measurement of water from many wells. The time when water soaked into the ground can be inferred for each sample from the variation of dissolved-gas content, and the ef-

fective velocity of ground water can be calculated thereby. The effective velocity observed in an aquifer consisting of coarse gravel ranges from 3.6 to 10 m. per day, corresponding to different hydraulic gradients. If these values are converted by Darcy's formula into the velocity along a 1% hydraulic gradient, they range from 36 to 58 m. per day.--Auth.

3-1325. Keller, Walter D. ACIDITY-ALKALINITY OF SURFACE DRAINAGE WATERS AS RELATED TO UNDERLYING SILICATE ROCKS: Jour. Sed. Petrology, v. 30, no. 4, p. 582-584, Dec. 1960, 4 refs.

Surface drainage waters in humid regions underlain by silicate rocks range in pH from about 2 units above to several units below neutrality. Alkaline waters were observed in regions underlain by pyroclastic rocks and nepheline syenite, whereas acid surface waters were measured where the underlying rocks were gneisses, granites, and certain other igneous rocks. The pH of the surface water is interpreted as being influenced by the hydrolytic (alteration) products of the rocks - the more alkaline water being associated with the silicate rocks most susceptible to hydrolysis.--Auth.

3-1326. Inerfield, Arthur J., and others. QUALITY OF GROUND WATERS IN CALIFORNIA 1957: California Dept. Water Resources, Bull. no. 66, 61 p. 7 pls., Apr., 1960.

More than 1,000 water samples from 43 ground-water basins or portions of ground-water basins in California are summarized, and interpretations are made with respect to definition of and evaluation of water quality problems.

Degradation by sea-water intrusion into coastal ground-water basins continued to be the major threat to quality of ground waters in California during 1957. Sea-water intrusion was evidenced by increased mineralization in ground water in 8 areas: Santa Clara Valley, Santa Clara and San Mateo counties; Pajaro Valley, Santa Cruz and Monterey counties; Salinas Valley, Monterey County; Oxnard Plain, Ventura County; West Coast Basin, Los Angeles County; East Coastal Plain, Orange County; San Luis Rey Valley, San Diego County; and Tia Juana Basin, San Diego County.

Ground-water quality in the majority of the monitored areas, including the vast Central Valley region, remained essentially unchanged from conditions in 1956. Significant increases or decreases in mineral concentration were noted in individual wells. However, these changes appear to be due to localized conditions and do not necessarily reflect basin-wide water quality trends.--R.C. Richter.

3-1327. Suter, Max, and Robert H. Harmeson. ARTIFICIAL GROUND-WATER RECHARGE AT PEORIA, ILLINOIS: Illinois State Water Survey, Bull. 48, 48 p., 42 figs. incl. 2 maps, diags., graphs, profiles, 5 tables, 1960, 25 refs.

Summarizes research and demonstration of the pit method of artificial recharge at Peoria and its contribution to solution of the problem of declining ground-water levels. Excessive withdrawals from the glacial drift aquifer at Peoria had resulted in progressive decline of the ground-water levels, and remedial measures were urgently needed.

Ground-water resources at Peoria are developed from 3 well fields and must meet the demands of the municipal supply as well as a variety of major water-using industries. Prior to 1959, most water needs were furnished from these ground-water resources. Since that time treatment facilities have been developed for direct use of water from the Illinois River.

Described in this report are the types of recharge pits and operating techniques developed by the Illinois State Water Survey and those which were built by local industries. Summaries of operating records over an 8-year period show capacity and cost information.--Auth.

3-1328. LaMoreaux, P.E. GROUND-WATER RESOURCES OF THE SOUTH - A FRONTIER OF THE NATION'S WATER SUPPLY: U.S. Geol. Survey, Circ. 441, 9 p., 6 figs., 1960, pub. 1961.

The Atlantic and Gulf Coastal Plain now produces about one-eighth of the estimated 240 billion gallons per day of water used in the United States for purposes other than waterpower, navigation, and recreation. About one-fourth of the approximately 32 billion gallons per day used in the Coastal Plain comes from wells. This region has the greatest potential for future ground-water development of any region in the United States.--U.S. Geol. Survey.

3-1329. Walters, Kenneth L., and Maurice J. Grolier. GEOLOGY AND GROUND WATER RESOURCES OF THE COLUMBIA BASIN PROJECT AREA, WASHINGTON. VOLUME I: Washington, Div. Water Resources, Water Supply Bull. no. 8, 542 p., 4 maps (3 in pocket), 24 hydrographs, 4 tables, 1960, 12 refs.

This volume represents the first phase of a program designed to 1) determine the availability and suitability of ground water for municipal supply, farm use, and industry within the Columbia Basin Project; 2) delineate areas that might eventually become waterlogged as a result of irrigation; 3) interpret chemical quality and chemical changes of ground water; 4) evaluate the possibility of pumping ground water for irrigation and/or drainage purposes. Vol. 1 contains factual data for hundreds of wells drilled within the project boundary and a brief summary of water-level changes that have occurred as a result of project irrigation. Vol. 2, scheduled for release in 1961, will contain a discussion of the occurrence and movement of ground water; the geology of the Columbia Basin Project, with special emphasis on the stratigraphy of the Columbia River basalt, and a thorough analysis of the effects of project irrigation on the regional water table.--From foreword.

The area covered in this report [about 3,900 sq. mi. of Grant, Franklin, and Adams counties] is a part of the extensive Columbia River plateau, which was formed by the extrusion of lava during the Eocene, Miocene, and Pliocene(?) epochs throughout a large part of eastern Washington, eastern Oregon, and western Idaho.

After basalt was extruded, the region was warped into the form of a broad basin, in which several subbasins were formed by locally steeper folding and by faulting. In these subbasins, deposits of clay, silt, sand, and gravel accumulated during the Pleistocene epoch.

Also during Pleistocene time, and continuing into Recent time, the area has received deposits of silt and sand carried by the wind. These eolian deposits in part are being reworked and shifted by the winds at the present time.

The basalt bedrock and coarse-grained sedimentary deposits in the subbasins constitute the important sources of ground water in the area. The basalt ridges that separate the subbasins also are important to the occurrence of ground water in that they may act as ground-water barriers, retarding the movement of ground water from one subbasin to the other.--From auth., p. 7.

Rock units and their water-bearing characteristics are briefly described; also effects of irrigation upon water levels. The major part of the report consists of 3 tables giving well records, chemical analyses of water from wells, and logs of wells, and a set of hydrographs showing water-level fluctuations in selected observation wells.

3-1330. Noble, John B. A PRELIMINARY REPORT ON THE GEOLOGY AND GROUND-WATER RESOURCES OF THE SEQUIM-DUNGENESS AREA, CLALLAM COUNTY, WASHINGTON: Washington, Div. Water Resources, Water Supply Bull. no. 11, 43 p., 2 maps (in pocket), secs. (in pocket), 4 tables, 1960, 11 refs.

The Sequim-Dungeness area in the northeastern part of the Olympic Peninsula is composed chiefly of glacial outwash material graded from the Olympic Mountains to the Strait of Juan De Fuca. The area is in a rain shadow which allows an annual average precipitation of only 16.92 in.

Topography within the project area is planar except where complicated by ice-contact features and older stream terraces. The Dungeness River provides the largest single drainage channel; many smaller drainage ways, natural and artificial, also exist.

The area is developed primarily upon thick deposits of Pleistocene sands and gravels derived from recessional glacial outwash. Those outwash deposits that serve as aquifers are probably from Vashon age glaciation. Mixed with the permeable sand and gravel outwash are deposits of fine, impermeable material deposited as glacial lake deposits or as ground moraine. Some of the outwash material remains as it was originally deposited. Most of the outwash material has been re-worked by the Dungeness and neighboring streams as they carved surfaces graded from the mountains to a base level that has lowered at a nonuniform rate since Pleistocene time. As the base level lowered, downcutting streams left remnants of several terraces. Most terraces are mantled with thick silt deposits and have relatively higher altitudes. This combination requires deeper wells to penetrate the regional water surface. The surface graded to present sea level has a thinner mantle of fine materials and a relatively lower altitude so that shallower wells are possible.

Most wells tap unconfined ground water, but irregularly located impermeable deposits may cause local areas of confined ground water. Majority of ground-water recharge probably moves from the mountains, but local precipitation and losses from irrigation are also important factors. The recharge from irrigation is apparently responsible for the occurrence of highest water levels in summer. Artificial discharge has shown no apparent effect on the status of the water table.

Areas with surfaces graded directly to the Dungeness River and streams to the E. are most productive of ground water. Water-logged areas also occur here and may perhaps be drained by pumping of large diameter wells. Happy Valley is an area which could possibly be developed by proper recovery of ground water. The northern and southern perimeter of the report area show the least likely spots for production of ground water.

Chemical analyses indicate hard but otherwise suitable water.--Auth.

3-1331. Doll, Warwick L., and others. WATER RESOURCES OF KANAWHA COUNTY, WEST VIRGINIA: West Virginia, Geol. & Econ. Survey, Bull. 20, 189 p., 29 figs. incl. map, graphs, 4 pls. incl. 3 maps (1 fold.), profiles, 30 tables, 1960, 23 refs.

Kanawha County comprises 913 sq. mi. of West Virginia in the S.-central part of the state. The Kanawha River flows northwestward through the central part of the county. An investigation to bring together the surface, underground, and quality aspects of the water resources of Kanawha County was begun in the fall of 1956 by the U.S. Geological Survey in cooperation with the County Court of Kanawha County, and with the assistance of the West Virginia Geological and Economic Survey.

Sufficient water is available in the Kanawha River basin to meet the requirements for the present and for many years to come, if water use increases at about the present rate. The average flow of the Kanawha River at Charleston during the period 1940-1957 was about 9,150 m.g.d. (million gallons per day). The estimated use (excluding waterpower) of surface water and ground water of about 1,410 m.g.d. in Kanawha County represents about 16% of the main flow at Charleston. A large portion of the water withdrawn is used for cooling and is returned to the river unchanged except for a rise in temperature. Most of the remainder is used by industry and is returned to the river more or less contaminated. Relatively little water is permanently withdrawn.

The importance of ground water in Kanawha County is shown by the large number of people who depend upon this source of water supply and by the magnitude of present ground-water use. About one-fourth of population depends upon ground water for its domestic needs, the daily use for this purpose being about 3.3 million gallons. Industries use about 4.6 m.g.d. of ground water in the summer and about 1.1 m.g.d. in the other seasons. The total use of ground water amounts to about 8 m.g.d. in the summer and 4.5 m.g.d. in the other seasons.

Most of Kanawha County is underlain by consolidated rocks of Pennsylvanian age, chiefly sandstone, but they also contain considerable shale and some coal, limestone, and clay. The rocks are gently folded along axes that trend generally northwestward. Most of the ground water is derived from the sandstones.

The large-capacity industrial wells are in the major valleys and are close to streams, where the topographic and hydrologic conditions apparently are most favorable for wells of relatively high yield. Drilled wells in the county range in depth from about 20 to about 600 ft. and average about 110 ft. Yields range from less than 1 to as much as 600 gallons per minute (g.p.m.). The average yield of wells varies significantly with the series of rocks tapped by the well. In the Pottsville Series it is 118 g.p.m.; in the Allegheny Series, 125 g.p.m.; and in the Conemaugh Series, 13 g.p.m.

The water above 300 ft. in the consolidated rocks is generally chemically suitable for domestic and most industrial uses. However, in some places even the shallow water is somewhat mineralized and corrosive. Throughout most of the county, progressively higher concentrations of salty water are encountered with increase in depth. Water from the deeper aquifers is used for cooling and condensing

in several industrial plants. Salt-water contamination of the shallow aquifers in some areas may have resulted from the upward migration of the brine along natural passageways and by leakage through abandoned wells and test holes that were improperly sealed.

The temperature of the shallow ground water ranges from about 55° to 65°F. throughout the year. This relatively uniform temperature is desirable for air conditioning and for industrial cooling processes.

Moderate supplies of ground water are available from gravel and sand beds in the alluvium of the Kanawha River valley. Large-diameter wells tapping the alluvium have an average yield of about 85 g.p.m. The alluvium averages about 50 ft. in thickness and consists of clay, silt, sand, and gravel. The water table lies about 20 ft. below the land surface, so that the alluvium has an average saturated thickness of 34 ft. Aquifers capable of yielding very large quantities of ground water probably are not present in the Kanawha Valley alluvium. However, in several places along the river, where conditions are favorable to induced infiltration of river water, moderately large yields may be developed.

Water from the alluvium varies in chemical composition. It may be very soft or very hard, but generally is rather high in Fe. A greater fluctuation in temperature and chemical composition of the ground water must be expected in areas where induced infiltration causes a mixing of river water with the ground water, but the temperature range is much less than that of the river water.

Water in both the alluvium and the consolidated rocks can be contaminated by industrial wastes if care is not exercised. At least one user has experienced contamination by industrial wastes of well supplies developed in the alluvium. Another found that underground leakage from chemical-process pipelines was contaminating ground water in the consolidated rocks.

Currently, there appears to be no danger of a shortage of ground water in Kanawha County. Prior to 1948, heavy development of the consolidated aquifers in the Charleston business district decreased substantially the yield of some of the industrial and air-conditioning wells. Many of these wells were abandoned because of high operating costs, unsuitable quality of the water, and decreased yields of wells. This decrease in pumpage has alleviated the problem of decreasing well yields. Present major groundwater developments in Kanawha County are rather evenly distributed along the Kanawha River valley and some of the other major valleys. Considerable additional ground water is available provided the development is judiciously planned and implemented. --From auth. summ.

12. MINERAL DEPOSITS

See also: Geologic Maps 3-1034, 3-1037, 3-1038, 3-1052, 3-1053, 3-1054; Geophysics 3-1238; Mineralogy 3-1261; Igneous and Metamorphic Petrology 3-1284.

3-1332. Zhilkin, N.G. FEASIBLE NEW METHODS OF PROSPECTING AND EXPLORATION. Translated by Eugene A. Alexandrov: Internat. Geology Rev., v. 3, no. 1, p. 71-77, Jan. 1961.

The Ministry of Geology and Conservation of Mineral Resources, U.S.S.R., announces the winners of its May 1956 contest for the best papers on improved prospecting methods for hidden ore deposits, and methods developed for prospecting specific areas for specific minerals. The top 11 award-winning presentations include: 1) a program of placer prospecting in the Soviet NE. incorporating vertical electric sounding; 2) a program for prospecting buried hydrothermal vein deposits in the Soviet NE.; 3) a method of in-place radioactive-ore prospecting; 4) a method of prospecting for nonplacer Au by spectral analysis; 5) directional-drilling in exploring salt-dome structure; 6) a method of soil analysis in geochemical prospecting for mineral halos; 7) a portable plant for taking placer-prospecting samples; 8) improved exploratory methods in molybdenite deposits; 9) an improved method of prospecting deep vein deposits; 10) a 3-dimensional seismic prospecting method for subsurface structure; and 11) a method for estimating ground-water reserves in karst and highly fractured areas.--M. Russell.

3-1333. Sergeev, E.A. METHODS OF MERCUROMETRIC INVESTIGATIONS. Translated by Ivan Mittin: Internat. Geology Rev., v. 3, no. 2, p. 93-99, map, 6 diags., Feb. 1961, 2 refs.

A spectroscopic method of analysis of rocks for the presence of Hg in minute concentration is described. Sensitivities to 0.02 p.p.m. are possible. Its usefulness in geochemical exploration is illustrated by application of the technique to the Khaydarken ore field. Variants of the method and examples of other successful field applications are given. --M. Russell.

3-1334. McVay, T.N. FIELD TEST FOR BERYLLIUM MINERALS: THE MORIN FLUORESCENCE METHOD: U.S. Bur. Mines, Rept. Inv. 5620, 10 p., illus., table, 1960, 11 refs.

The various applications of Be and its compounds in atomic-energy technology and a growing recognition of possible increased utilization of the metal in the aircraft and space-missile fields have resulted in increased interest in domestic and world reserves of Be.

Little dependable data on Be resources and reserves are available, as past consumption of the element has been small and only limited prospecting and exploration work has been done. The scarcity of resource information is attributed partly to the difficulty of recognizing Be minerals in the field. These minerals frequently do not have distincitve characteristics of specific gravity, color, or other physical properties that enable ready identification by the average prospector. This is particularly true of fine-grained minerals.

As a result, a simple field test for identifying Be-bearing rock is needed. Technologists of the U.S. Bureau of Mines investigated several of the proposed qualitative chemical tests for Be. This report describes various modifications of one of these methods to make it more suitable for use in the field.

In the modified method, duplicate samples are fluxed - one with potassium bifluoride and one with potassium bisulfate - followed by dissolution of salts in water, conversion of the solution to an alkaline condition, addition of morin, and examination of the solution for fluorescence under short-wave ultraviolet light. This method provides a fast, dependable field test for Be minerals containing as little as 0.2%

beryl or its equivalent.

The test involves no radiation hazards, and it can be performed by persons having no technical training; therefore, it should be useful to prospectors in discovering Be mineralization.--Auth. summ

3-1335. Netreba, A.V. AGE OF THE NORTHWEST CAUCASIAN PYRITE MINERALIZATION: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 71-81, 7 figs., 3 tables, pub. 1960, 25 refs.

A microscopic study of ores reveals a stage sequence of mineralization, idependent of the regional metamorphism. The presence of the mineralization phases has been confirmed by general geologic data. Pressure in post-ore tectonic pushes was commonly considerable, enough to produce, in individual segments, a regular orientation of sphalerite aggregates with relation to the banding. An irregular, unpredictable orientation of sphalerite grains is more common, which confirms a primary, pre-ore, formation of banding in the crystallization of ores. However, the coincidence of the optical orientation of albite grains with the banding of albite-chlorite schists testifies to a metamorphic alteration of greenstone rocks. The schistosity and the change in the mineral composition of the enclosing rocks was, on the whole, terminated before the ore making, which is unequivocally attested by the "floating" fragment of these rocks in the ore. The other metamorphic features of the ores have no adequate explanation and remain controversial.

The pyrite ore bodies are subsequent to the regional metamorphism. A coincidence of the last stages of the regional metamorphism and the onset of ore making is quite probable. This is the explanation of some metamorphic phenomena in the ores, such as crumbling.

The intensive tectonic-igneous activity in the front range province, and the ore making, occurred in the pre-upper Carboniferous. Accordingly, the object of the search for pyrite ores in the northern Caucasus should be structures including older igneous and sedimentary formations.--From auth. summ.

3-1336. Magee, J.B., and W.W. Cummings. THE MINERAL KING MINE: Can. Mining & Metall. Bull., v. 53, no. 578, p. 389-391, June 1960, 2 refs.

The Mineral King Mine, owned and operated by Sheep Creek Mines, is located in the Purcell mountain range of southeastern British Columbia. Production of Pb and Zn concentrates commenced in 1954, some 60 years after the initial discovery. Low cost mining methods have been employed to extract 16,000 tons of ore monthly from large ore bodies formed by replacement in limestone. Extensive areas in the limestone are yet to be explored, and success in the search for new ore bodies is anticipated.--Auth.

3-1337. Grosh, Wesley A. SHALLOW LEAD DIGGINGS, GRANT AND LAFAYETTE COUNTIES, WIS.: U.S. Bur. Mines, Rept. Inv. 5694, 59 p., 18 figs. incl. 5 illus., maps, chart, secs., 19 tables, 1960, 3 refs.

Results of this investigation indicated that at least a trace of Pb and Zn mineralization is present in all areas sampled. The grade of the residual mineralization is generally low. The galena is in a very finely divided state, which presents difficult recovery problems. Within the area sampled, several highly mineralized zones were found. This higher degree of mineralization could usually be associated with one or more of 3 principal factors: 1) The old dumps or spoil materials from earlier mining operations are definitely of higher grade than the unmined residual top soils and clays, and any dump material in the digging area would increase the expected grade. 2) Usually, the residual galena mineralization is concentrated near bedrock. Although this fact was not too well established, as only a few areas were tested, the condition is expected to be the same in other areas. 3) Samples taken in close proximity of known crevices showed a decided increase in the degree of mineralization, which could be partly due to the presence of old fill or dump material. However, the residual material directly above known crevices is decidedly higher in mineral content than elsewhere.

The over-all grade of a plot of ground would be largely dependent upon these 3 factors; most important probably would be the ratio of dump material to undisturbed ground. As this ratio would be difficult to determine, a major consideration of any preliminary sampling program should be a study of earlier mining operations.

Recovery of the finely disseminated sulfide mineralization presents a difficult problem, not only because of the physical condition of the mineralization itself but because of the large amount of slime associated with it.

Work on the alluvial deposits of the New Diggings Branch of the Fever River, although inconclusive, did show some consideration of mineralization in the shallow valleys. The possibility that placer-type deposits may be a possible source of Pb should receive further consideration.--From auth. concl.

3-1338. Ridge, John D. THE EXPLOITATION OF ARIZONA COPPER RESOURCES: Mineral Industries, v. 29, no. 4, p. 9-11, map, 2 tables, Jan. 1961.

From 1941 through 1959, Cu production in Arizona climbed from 33.2 to 51.2% of the United States total. During that same period, the state's Cu production rose from 20.3% of United States consumption to 41.2% (in 1958). Although the incentives to increased production have been much the same throughout the nation, the search for, exploitation of Cu deposits in Arizona has been far more successful than in any other state. Tables are presented which show the production of Cu ore in Arizona from 1941 through 1959 by mining districts, and the meanings of the fluctuations indicated by these data are discussed. Further data are given on Cu metal produced from Arizona ore, average grade by years, Arizona percentages of United States production and consumption as well as the values of national indices during the period. The principal events that occurred in each district during the 19-year period are briefly discussed.--Auth.

3-1339. Walker, David D. TUNGSTEN RESOURCES OF MONTANA: DEPOSITS OF THE PHILIPSBURG BATHOLITH, GRANITE AND DEER LODGE COUNTIES: U.S. Bur. Mines, Rept. Inv. 5612, 55 p., 32 figs. incl. maps, secs., 4 tables, 1960, 4 refs.

Scheelite, the most abundant W mineral in the Philipsburg region of Montana, is found in replacement deposits and along fissures and cracks in limestone at various distances from contacts with acidic igneous rocks. It also occurs at the limestone-

igneous contacts, but typical garnet tactites are developed in only a few places in the region. The most favorable host rocks for scheelite mineralization are the Jefferson [Middle Devonian], Hasmark [Upper Cambrian], and Madison [Mississippian] limestones.

Scheelite is exposed in float, outcrops, and surface and mine workings along a 2-mi.-wide belt extending SW. from Lost Creek beyond Silver Lake, a distance of 15 mi. or more. Some scheelite is found in veins formerly mined for Ag. Powellite and molybdenite occasionally are present with the scheelite. Hubnerite occurs in quartz veins in the Black Pine area 10 mi. NW. of Philipsburg. These quartz veins occur in the quartzites of the Precambrian Spokane formation.

W production in the region has come almost exclusively from scheelite deposits, both lode and placer. During a 6-year period beginning in 1943 a total of 142.0 tons of 63% WO_3 concentrate was produced by H & H Mines Co. In the early 1950's, the Trigger mine produced 4,000 tons of 1% WO_3 ore and the Tip Top 650 tons of 2.0% WO_3 ore and 2,906 tons of 2.2% ore. There has been sporadic production from some of the smaller properties in the area.--Auth.

3-1340. Magill, Elwin A. MANGANESE DEPOSITS OF THE OLYMPIC PENINSULA, WASH.: U.S. Bur. Mines, Rept. Inv. 5530, 82 p., 54 figs. incl. illus., maps, secs., table, 1960, 33 refs.

This report is one of a series prepared by the U.S. Bureau of Mines on Mn deposits of the northwestern states. It describes properties on the Olympic Peninsula, Washington.

Exploration by the U.S. Bureau of Mines in 1939-1940 and 1954-1955 on several typical deposits is summarized, and examination data are presented for other Mn deposits on the peninsula. An attempt was made to list all known occurrences; however, some properties are abandoned, and their exact location is unknown.

The report describes 67 deposits, of which nearly three-fourths are grouped in a relatively small area in Clallam County; the remainder are distributed about equally in Jefferson, Mason, and Grays Harbor counties. Twelve deposits have produced Mn ore; however, more than 95% of the total Olympic Peninsula Mn production has come from the Crescent mine in Clallam County.

Minerals in the deposits examined are predominantly manganese silicates, and the ore bodies generally occur as small (less than 100 tons) lenticular deposits. Grades usually range from 10 to 25% Mn and 15 to 30% SiO_2. A notable exception is the Crescent mine, where hausmannite (Mn_3O_4) is the principal mineral.--Auth.

3-1341. Abshire, Eleanor, and Sarah Notestine. BIBLIOGRAPHY OF HAFNIUM: U.S. Bur. Mines, Inf. Circ. 7928, 30 p., 1960.

The increasing use of hafnium as a vital component in atomic power reactors has brought this metal into recent prominence.

A literature survey was made, and this bibliography of 670 sources was compiled to provide research and production groups with a ready source of reference to this important metal and its compounds.

The material in this bibliography is arranged alphabetically by authors. Secondary authors are cross-indexed. Titles of periodicals or organizations are used as the authors of anonymous references.--From auth. introd.

3-1342. Gilkey, Millard M. HYATT RANCH PEGMATITE, LARIMER COUNTY, COLO.: U.S. Bur. Mines, Rept. Inv. 5643, 18 p., 2 illus., 2 maps, sec., table, 1960, ref.

Pegmatites in Colorado occur for 150 mi. along the Front Range (easternmost range of the Rocky Mountains) from Larimer County on the N. to Canon City on the S., and W. into the Gunnison area. Many of the deposits have been classified. Minerals found in the various dikes include beryl, scrap and possibly punch mica, Li-bearing minerals, columbite-tantalite, feldspar, and several rare minerals.

Pegmatites are abundant in the Crystal Mountain district in Larimer County. About 5 mi. S. of the Crystal Mountain district and often identified with that district is the Hyatt pegmatite area. The Hyatt Ranch deposit has attracted particular attention because of the comparatively high beryl content of the upper part exposed in opencut workings.

The geologic age of the pegmatite and of the enclosing schist and granite is Precambrian. The pegmatite strikes northeasterly and dips northwesterly. It is a roughly lenticular body 365 ft. long and has a maximum width of 70 ft. Near its center, it appears to bottom about 200 ft. vertically below its surface outcrop. Besides a discontinuous border zone, it is divided into 4 internal zones: a wall zone, outer intermediate zone, inner intermediate zone, and core zone. Most of the beryl is found in the inner intermediate and wall zones. Muscovite occurs principally in the inner intermediate zone. Chemical and microscopic studies indicate that beryl and mica are the only potentially valuable minerals in the deposit. The K feldspar present is of low quality.

Information gained from exploratory diamond drilling done by the U.S. Geological Survey and examination of the surface workings indicated that the Hyatt Ranch deposit might contain a substantial tonnage of beryl-bearing pegmatite of a grade sufficiently high to warrant beneficiation. The purpose of the U.S. Bureau of Mines project at the Hyatt Ranch pegmatite was to investigate the following: 1) extent, grade, and distribution of beryl and other economically important minerals, 2) possibilities for selective mining, 3) feasibility of hand sorting, and 4) amenability of the ore to metallurgical beneficiation.

Project work began Sept. 18, 1950. The diamond drilling revealed that about one-half of the deposit lies below the adit level and that the underlying portion is similar in grade and mineral distribution to the middle portion penetrated by the adit. The grade is too low for economic operation at present prices, and selective mining offers no solution. Results of the attempt to concentrate the beryl and mica by hand sorting were disappointing. Although 60% of the mica in the ore was recovered by hand sorting, only 18% of the beryl was recovered by this method.

In June 1953, two 7-ton samples were taken from the adit level for metallurgical testing. One sample, taken in the inner intermediate zone, assayed 0.065% BeO (beryllium oxide). The other was taken from the wall zone and contained 0.022% BeO. The results of the metallurgical experiments were satisfactory for mica but were unfavorable for beryl. The highest grade beryl concentrate obtained by flotation assayed only 4.5% BeO, and the recovery of beryl was only 45%.--From auth. summ.

3-1343. Stewart, Lincoln A., and A.J. Pfister. BARITE DEPOSITS OF ARIZONA: U.S. Bur. Mines, Rept. Inv. 5651, 89 p., 23 figs. incl. 4 illus., maps, graph, 1960, 10 refs.

This paper describes all occurrences of barite in Arizona that were known or reported to the authors. The history, ownership, production, and geologic setting are discussed for most of the deposits. The uses and specifications of product grades are briefly discussed.

Seventy-five deposits were examined in 9 of the 14 counties of the state. The descriptions are given under county headings. No occurrences were reported in the 4 northeastern counties of Coconino, Navajo, Apache, and Greenlee, nor in Santa Cruz in the southern part of the state.

From about half of the deposits examined, 55 samples were taken; of these, 45 were for chemical analysis, and 8 larger samples, ranging from 100 to 350 lbs., for beneficiation tests. A 30-ton bulk sample was taken for pilot-plant tests. Bench-scale flotation tests of the 8 samples employing several different procedures and reagent combinations yielded marketable-grade barite products with barite recoveries ranging from 60 to 97%. Five of the samples contained enough fluorspar to warrant its recovery. Acid-grade concentrates, which accounted for fluorspar recoveries of 45 to 70%, were obtained from 3 of these ores. Batch laboratory tests of a representative portion of the 30-ton bulk sample revealed that acid-grade fluorspar and high-grade barite concentrates could be recovered. Results of the laboratory and continuous pilot-plant tests of this ore will be presented in a separate report.

In virtually all the deposits the barite mineralization was confined to faults or fracture zones, most in igneous, some in sedimentary, and a few in metamorphic rocks.. In about half the occurrences, fluorspar was associated with the barite in quantities varying from a few tenths to as much as 30%.

Barite production in Arizona first was recorded in 1925. The total production of barite from Arizona has been more than 300,000 tons; about 98% was from the Granite Reef deposit in Maricopa County from 1931 to 1955. Eight other deposits are credited with the remainder of the production in intermittent, relatively small tonnages from 1929 to 1955. There has been no production since the latter date, but in 1958 several large companies optioned promising properties.--Auth. summ.

3-1344. Shabynin, L.I. DISTRIBUTION AND FORMATION CONDITIONS FOR BORON CONCENTRATION IN ENDOGENETIC BORATES OF SKARN DEPOSITS: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 3, p. 63-70, table, pub. 1960, 8 refs.

Three types of industrial deposits of B occur: 1) exogenic (halogene-sedimentary), 2) volcanic-sedimentary, and 3) endogenic. The volcanic-sedimentary type is the most likely to provide commercial quantities of B in the U.S.S.R. Most deposits are located in young folded zones, Mesozoic and Alpine, and in areas where crystalline shields are in contact with limestone. A facies study of dolomite regions is needed.--A. Eustus.

3-1345. Shobolov, S.P. GEOLOGIC STRUCTURE AND ORIGIN OF THE OGLANLY BENTONITIC CLAYS (TURKMENIAN S.S.R.): Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 80-86, illus., map, secs., pub. 1960, 5 refs.

The Oglanly bentonite ("oglanlite") [located 137 km. E. of Krasnovodsk, Caspian Sea] is an alkaline montmorillonitic, high-grade, finely dispersed clay. Electron-microscope and X-ray study demonstrated the presence of cristobalite in bentonite, which is explained by the volcanic nature of the clay source material.

The large amounts of Radiolaria and Foraminifera, together with the lateral changes of bentonite to marl, suggest that the deposition and decomposition of volcanic ash took place in a marine environment.

Intercalations of volcanic ash in southwestern Turkmenia may constitute evidence of bentonitic clays. Especially promising are Paleogene deposits W. of the western sector of the Oglanly deposit.--Auth. summ.

3-1346. Dawson, John A.M. THE PIONEERING OF NEPHELINE SYENITE: Can. Mining Jour., v. 82, no. 1, p. 31-34, 2 illus., Jan. 1961.

On Blue Mountain in eastern Ontario, nepheline syenite is quarried, and a 1,000 ton per day mill is in operation. Explored reserves are reported to be close to 7 million tons; potential reserves are very large and incalculable.

The history of the exploitation of the deposit is given, beginning with recognition of the syenite in 1899, through development in the 1930's, to the present stage in which the product is firmly entrenched in the glass and ceramic industries.

Comments are included on the petrology of nepheline syenite, on other deposits in Ontario, and on technologic aspects of milling and uses.

It is suggested that research consideration be given to economic processes for converting nepheline syenite into china clay, using natural gas for heat, carbon dioxide, and water.--W.C. Peters.

3-1347. Huffman, George G. OKLAHOMA CEMENT COMPANY OPENS NEW PLANT NEAR PRYOR: Oklahoma Geology Notes, v. 20, no.11, p. 282-286, 2 illus., map, Nov. 1960, 3 refs.

In July 1960, the Oklahoma Cement Company began operation in a new $8 million plant located 5 mi. E. and 2 1/2 mi. S. of Pryor, Mayes County. The plant is capable of processing 1,000 to 1,200 tons of raw material per day, and the operators expect to produce 1,000,000 barrels of cement per year.

The plant is located near the center of the E. half of sec. 25, T. 21 N., R. 19 E. The surface rock in the vicinity of the plant is the Hindsville limestone [Mississippian], and a small outlier of Fayetteville shale and limestone [Mississippian] is located immediately to the S. of the plant. Materials from the Hindsville and Fayetteville are to be utilized in the manufacture of the cement.

Chemical analyses indicate that the Fayetteville formation contains approximately 60.66% $CaCO_3$ and 21.84% SiO_2. The Hindsville contains a calculated 89.5% $CaCO_3$ and 5.60 to 5.84% SiO_2.--Auth.

3-1348. Sobolev, V.S. THE DIAMOND DEPOSITS OF IAKUTIIA [in translation]: Can. Mining Jour., v. 82, no. 1, p. 35-36, Jan. 1961.

Soviet geologists have discovered rich alluvial and primary diamond deposits in western Yakutia. Reserves are sufficient for a powerful diamond mining industry. One hundred and twenty kimberlite bodies, many of them diamondiferous, have been

discovered within the limits of the Siberian platform.

Mention is made of new geologic data and new interpretations of the petrology of kimberlite bodies. It is established that the mineral-forming process in kimberlite has 3 phases: 1) crystallization of olivine, ilmenite, pyrope, chromite, and diamond under calm thermodynamic conditions; 2) crystallization of the basic mass minerals under sharply decreasing pressure and possibly with a fall in temperature; 3) secondary and hydrothermal processes. --W.C. Peters.

3-1349. Pye, Edgar George. MINERAL DEPOSITS OF THE BIG DUCK LAKE AREA, DISTRICT OF THUNDER BAY: Ontario, Dept. Mines, Prelim. Rept. 1961-1, 90 p., 6 maps (Prelim. Map P. 87, scale 1 in. to 1/4 mi., with legend, separate), sec., Feb. 1961, 14 refs.

The Big Duck Lake area is located N. of Lake Superior, 15 mi. N. of Schreiber on the transcontinental line of the Canadian Pacific Railway (48°58'15"-49°02'N. 87°14'30"-87°25'W.). Examination of mineral deposits was made during 1960 and the results shown on the preliminary geologic map P. 87 (previously listed separately as GeoScience Abstracts 3-11).

All consolidated rocks are Precambrian. They make up 4 groups, assigned provisionally to the Keewatin, pre-Algoman(?), Algoman, and Keweenawan systems. The oldest formations, representing the Keewatin, form a belt up to 4 mi. wide, that extends for about 18 mi. E. from Winston Lake. Field determinations indicate that everywhere their tops face to the N. or NE. On this basis they have been subdivided into 3 parts: 1) lower metasediments, exposed E. of Winston lake; 2) metavolcanics; and 3) upper metasediments, exposed along the N. side of the belt. Younger than the Keewatin formations are basic igneous rocks of pre-Algoman(?) age, and acid porphyries and granitic rocks of Algoman age. The youngest consolidated rock in the area is Keweenawan diabase, which occurs as narrow, persistent dikes that cut transversely or obliquely across the regional structures.

A wide variety of mineral deposits exists in the Big Duck Lake area - discoveries of Au, Ag, Zn, Pb, Cu, and even Mo and W have been reported - and from 1898 to 1901, one of them, the Zenith, was mined for its Zn content. Most of the deposits have been tested by stripping and trenching and, in many cases, also by diamond drilling. As indicated on the map of the area, they can be classified on the basis of their principal metallic constituents. This classification is useful and serves to emphasize a rather crude zonal distribution of precious metals and Mo in those deposits in the vicinity of Big Duck Lake and of Zn in those near Little Duck Lake and in the W. part of the area. The deposits may also be classified, according to the character of the mineralization, as massive sulfide deposits, disseminated sulfide deposits, and vein deposits. These are described separately.--From auth., p. 9-10, 40.

3-1350. Shcherbakov, D.I. GEOLOGIC SCIENCE AT THE TIME OF THE XXI CONGRESS OF THE COMMUNIST PARTY OF THE U.S.S.R.: Akad. Nauk SSSR, Izvestiya, Geol. Ser., in translation, 1959, no. 1, p. 1-4, pub. 1960.

Importance of the geological sciences in the 7-year plan (1959-1965) for Soviet industry is stressed. One of the most important tasks is to further develop the principles of occurrence of minerals, according to the theories of N.S. Shatsky. All prospecting operations should be divided into separate groups, each concerned with the following minerals: minerals of sedimentary origin; minerals of magmatogenic origin; oil and gas; coal and bituminous shales; rare and dispersed minerals. As yearly production of oil must reach 240 million tons and gas 150 billion cu. m., new fields must be developed.--M. Russell.

13. FUELS

See also: Geologic Maps 3-1033, 3-1055, 3-1056; Areal and Regional Geology 3-1077; Stratigraphy 3-1140, 3-1141; Paleontology 3-1184; Geophysics 3-1218; Geochemistry 3-1249; Sedimentary Petrology 3-1313; Mineral Deposits 3-1332, 3-1350; Engineering Geology 3-1366.

3-1351. Swanson, E.B., comp. A CENTURY OF OIL AND GAS IN BOOKS; A DESCRIPTIVE BIBLIOGRAPHY: 214 p., New York, Appleton-Century-Crofts, 1960.

A bibliography of approximately 2,700 annotated references to items published commercially or privately in English and dealing directly or essentially with some aspect of petroleum. Attempt was made to list all available material known to the compiler up to Aug. 1959. Fiction was not included, nor were items covering broad fields of chemistry, geology, or other material not written with specific application to some aspect of petroleum. Promotional material lacking essential educational application or historic interest, and books dealing with equipment for utilizing petroleum products were eliminated. No attempt was made to list reprints of articles which appeared originally in periodicals generally available to the oil industry or which were published subsequently in proceedings of meetings which are accessible to persons in the oil and gas industries. Reports issued by federal agencies with established responsibilities for oil and gas matters were not listed, nor were reports resulting from Congressional committee investigations. Reports of state governments dealing with specific local areas or covering activities of a single year or so were not included, except in the case of outstandingly historical oil fields. An effort was made, however, to include representative reports on oil and gas prospects and developments for as many states as possible.--From introd.

References are listed under the following subjects: origin and finding of oil; drilling and production; oil and gas law; oil fields and areas of western hemisphere, eastern hemisphere; natural gas and natural gasoline; oil shales and shale oil; conservation of petroleum; world oilfields, international oil relations; properties and processing of petroleum; petroleum products; transportation and storage; commercial, financial, and economic matters; history and biography; reference works; general books; serials and periodicals.

3-1352. Tanner, William F. PALEOGEOGRAPHY: COASTAL STUDIES PROVIDE MORE QUESTIONS THAN ANSWERS: Shale Shaker, v. 11, no. 3, p. 14-17, 2 maps, table, Nov. 1960, 6 refs.

Paleogeography for the oil seeker deals chiefly with coastal environments, coastal features, and coastal deposits. Geologists like to believe that the present is the key to the past. Therefore, an intensive study of coastal areas is under way. The work described briefly is on and around the delta of the Apalachicola River in the panhandle of Florida. Various methods of study are described and their results. Sand grain studies have indicated that size and sorting are inconclusive as to environment or type of transportation. Ripple mark studies provided fairly good indications of water depth, plus suggestions of the orientation of the shoreline, but little other information. Many other observations not reported here or in the more technical literature were also made.

The result of these studies indicated that a composite approach seems to offer the best hope for a reliable paleogeographic interpretation and conclusions reached from individual studies may be erroneous.--C.E. Branham.

3-1353. Sheinman, A.B., and A.I. Sergeev. EXPERIMENTAL STUDIES OF COMBUSTION IN OIL SANDS. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no.1, p. 60-68, 13 figs. incl. diags., graphs, Jan. 1961, 7 refs.

Experiments on combustion in oil sands permit the determination and clarification of the combustion mechanics in oil-sand layers and the extraction of oil. To a considerable extent the problems of composition requirements of fuel within the mixture are clarified. A description of these fuels and the rate of movement in the combustion zone are presented. The various technical achievements of a given process are not sole bases of these conclusions; however, it should be mentioned that the thermal process of combustion extraction is not a universally adaptable method, as a sufficiently permeable layer is necessary. It also requires relatively heavy oil which does not completely saturate the pore space. Moreover, the sand must be relatively free of water or ignition is completely impossible.

A series of questions still have to be answered relative to such aspects as the lithological composition of the layer, the gas content, the thickness of the layer, the quality of the oil, and the speed of oxidation.--Auth. concl.

3-1354. Dobryansky, A.F., and others. CERTAIN RELATIONSHIPS IN THE COMPOSITION OF CRUDE OIL. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 1, p. 49-59, 8 tables, Jan. 1961, 17 refs.

Certain relationships in the composition of petroleum are reviewed as functions of their degree of transformation. The authors base their discussion on a thermodynamic analysis of the probability of a given reaction and on the actual analyses of petroleums. Reviewed data were limited to hexane isomers; data for other hydrocarbons confirmed the authors' conclusions.--Royer and Roger, Inc.

3-1355. Ashumov, G.G. NATURE OF NAPHTHENIC ACIDS IN BAKU CRUDE OILS AS A FUNCTION OF THE DEPTH OF OCCURRENCE. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 1, p. 42-48, 9 tables, Jan. 1961, 18 refs.

The author analyzes data on the contents of naphthenic acid in crude oils. Characteristics and properties of naphthenic acids in oils of adjacent formations are compared. The final conclusion denies the existence of any general relationship between the content of naphthenic acids and the depth of occurrence of oils of the deposits of the Apsheron peninsula.--Royer and Roger, Inc.

3-1356. Nazarkin, L.A. CLIMATE AND OIL GENESIS. Translated by Royer and Roger, Inc.: Internat. Geology Rev., v. 3, no. 2, p. 141-146, map, table, Feb. 1961, 22 refs.

Studies of the Caspian Sea, the Barents Sea, and others show that the rate of accumulation of organic matter in sediments and the nature of its initial change is largely dependent on climate. All known large oil pools are located in basins which had a warm environment at the time of deposition. Occurrences of gas in colder zones were associated with coal rather than oil. Exploration for oil in polar areas should be restricted to rocks known to have been deposited in warm paleoclimatic conditions. All evidence denies the inorganic theories for the origin of oil.--M. Russell.

3-1357. Stanfield, K.E., and others. OIL YIELDS OF SECTIONS OF GREEN RIVER OIL SHALE IN COLORADO, 1954-57: U.S. Bur. Mines, Rept. Inv. 5614, 186 p., 68 figs. incl. maps, secs., diags., logs, 66 tables, 1960, 16 refs.

This report presents information on oil shales [Eocene] of the Piceance Creek basin in the form of tables of oil-yield data and graphic logs for samples from 24 coreholes and 27 wells drilled during 1954-1957. In addition the oil yields of samples composing the maximum 15-gallon-per-ton section are tabulated for 11 wells - published previously as graphic logs. Revised logs of these 11 wells are presented for comparison with those of wells drilled more recently in the basin. Direct comparison of oil-yield logs for samples of the same type is facilitated by the use of one vertical scale for all core samples and a smaller vertical scale for all drill-cutting samples. Results of a statistical study to evaluate the reproducibility of the assay method are included also in the report.--From auth. summ.

3-1358. Campbell, W.G. OIL AND GAS EXPLORATIONS - EAGLE PLAINS AREA, YUKON TERRITORY: Can. Mining & Metall. Bull., v. 53, no. 580, p. 578-582, 3 maps, 2 secs., Aug. 1960.

The region discussed comprises approximately 8 million acres spreading across the Arctic Circle in Yukon and Northwest Territories.

Encouraged by 4 years of surface geological and geophysical work, which strongly suggested that suitable conditions existed for the entrapment of oil and gas, a decision was reached to drill. In due course 2 holes were drilled: Eagle Plains No. 1, drilled to 9589 in 1957-1958, and Western Minerals Chance No. 1, spudded in 1959, and being deepened this year.

Thick sections of sedimentary rocks occur on both sides of the Richardson Mountains. However, most activities have been concentrated to date on the W. side in the Eagle Plains basin. Here are found stratigraphic units ranging from Precambrian to Tertiary age. The drilling of the 2 exploratory wells proved the presence of these strata at depth and have confirmed the presence of promising struc-

tures. A geological cross section across Eagle Plains presents an interpretation of these conditions.

Physical and engineering aspects of exploration in the northern Yukon and Northwest Territories are dependent largely upon seasons and transportation. Reconnaissance gravity and surface geologic mapping by air presents no serious problems. However, seismic operations on the ground are greatly affected by the season, presence of permafrost and mobility of equipment.

The actual drilling of the hole may well be the simple part of a wildcat undertaking, once equipment and supplies are on location. Over-all planning, assembling supplies, and transporting equipment and personnel seems to be the real job. Serious consideration must be given to permafrost effect in the drilling program and on surface installations as well.

Programming for the various exploration activities should be undertaken well in advance of the actual doing. Considerable extra costs may be the results of crash programs.

Costs are high, and the rewards uncertain. Economic evaluation is based on the long-term outlook.--Auth.

3-1359. Smith, Derrell A. GEOLOGY OF SOUTH PASS BLOCK 27 FIELD, OFFSHORE, PLAQUEMINES PARISH, LOUISIANA: Am. Assoc. Petroleum Geologists, Bull., v. 45, no. 1, p. 51-71, 12 maps, 3 secs., log, Jan. 1961, 4 refs.

The South Pass Block 27 field, located in the coastal waters of Louisiana, is associated with an intermediate-depth salt dome. Only the N. flank of this salt-dome structure has been explored and developed, but proved reserves already exceed 200 million barrels of oil and 220 billion cu. ft. of gas. The field ranks high among the giant oil fields of Louisiana in terms of ultimate oil recovery. The unexplored areas show excellent productive promise, and the South Pass Block 27 field may eventually yield the largest field reserve yet found in the offshore waters of the Gulf of Mexico.

All production is from sands of Plio-Miocene age between the depths of 6,000 and 10,400 ft. One hundred and fifty-three producing wells have been completed, and cumulative production from these wells was 12,251,700 barrels of oil and condensate and 10,016,341 MCF of gas through Sept. 1959. Active development of the field is still in progress.

Contemporaneous faults traversing the structure have a marked effect on structural configuration. These faults are classified as contemporaneous because movement along the fault plane appears to have been contemporaneous with deposition over a part of the fault history. This type of faulting, commonly encountered in the Gulf Coast, is characterized by a greater thickness of sediments in the downthrown block than in the upthrown block and by an increase in throw of the fault with increasing depth. The major part of proved oil reserves is entrapped in the western part of the N. flank on the upthrown side of a large contemporaneous fault which strikes essentially N.-S.

Maps contoured on top of the "D_4" sand, the "N_4" sand, and salt are included to illustrate the structural aspects of the field. These maps are supplemented by structural cross sections and schematic diagrams. In addition structure maps on 4 typical producing beds are presented to delineate the more important producing areas of the field.--Auth.

3-1360. Jordan, Louise. OIL AND GAS IN KINGFISHER COUNTY: Oklahoma Geology Notes, v. 20, no. 12, p. 303-314, illus., map, secs., table, Dec. 1960, 14 refs.

Exploration and development drilling for hydrocarbons in Kingfisher County, Oklahoma, on the eastern flank of the Anadarko basin, has increased rapidly in 1960. Nine new fields were discovered in 1960 as compared with 13 found in the previous 4 years. Production of oil and gas has been found in sandstones and limestones at 10 stratigraphic positions in Ordovician, Devonian-Silurian, Mississippian, and Pennsylvanian rocks. Discoveries since 1955 in Mississippian rocks have been at 3 levels, the most important zone being the "Manning" limestone (Chester series) which grades eastward to sandstone and is truncated by post-Mississippian erosion. Fractured very coarse siltstone is the reservoir rock in the Meramec series (Mississippian). Oölitic limestone, called "Oswego," of Des Moinesian age (Pennsylvanian) is the present primary target for oil-production, although development drilling has resulted in discoveries in sandstones in the lower part of the Missouri series and in the Des Moines series below the "Oswego." Entrapment of hydrocarbons is primarily stratigraphic, with permeability an important factor, but at places slight structure appears to be observable.--Auth.

3-1361. Lytle, William S., and others. OIL AND GAS DEVELOPMENTS IN PENNSYLVANIA IN 1959: Pennsylvania Geol. Survey, Prog. Rept. 157, 55 p., 5 figs., 6 pls., 11 tables, 1960, 57 refs.

Increased interest in oil and gas exploration in Pennsylvania was shown during 1959, the centennial year of the petroleum industry. Exploration during the year resulted in the discovery of 1 new gas field and 6 new gas pools, the extension of several gas-producing areas, and the establishment of a new producing-depth record for the state.

A number of important dry exploratory tests were drilled during the year. Pennsylvania's second offshore well, in Lake Erie on Block No. 2, was plugged and abandoned after finding salt water in the Gatesburg (Upper Cambrian) formation. The Block No. 2 lease has been surrendered. A second well will probably be drilled on Block No. 1 lease during 1960. In the Seven Springs Field, Somerset County, a new pool wildcat was successful when Pa. Tract 75 No. 3 by Peoples Natural Gas Company found gas in the Onondaga chert (Middle Devonian) at 8,472 ft. - the deepest production in Pennsylvania. The well produced 10,933 MCF of gas (without fracturing) at a rock pressure of 3,400 p.s.i. in 10 days, and is the discovery well in the Kooser pool. Fayette County had the only new field discovery in 1959. The Mueller-Herr No. 1 well by Manufacturers Light and Heat Company found gas in the Onondaga chert on the Laurel Hill anticline, resulting in the discovery of the Ohiopyle field.

The greatest density of deep drilling was in the Clearfield County area where 3 pools were merged into one long field, the Punxsutawney-Driftwood field, extending almost 50 mi. in a NE-SW. direction.

A new shallow-sand (Upper Devonian or younger) gas pool was discovered when the Earl Young No. 1 well was drilled by James Drilling Company in Clearfield County. Production was from the Fifth sand. As in 1958 the secondary-recovery projects in the Bradford field and the development drilling in the gas fields dominated the shallow-sand drilling

activity during 1959.

Completions of all wells drilled by the petroleum industry in Pennsylvania during 1959 totaled 750, 37 less than in 1958. Of the 750 current completions, 726 were in proven fields and 24 were exploratory tests. Of the 726 proven fields wells, 223 were oil, 297 were gas, 129 were water input, 7 were for gas storage and 70 were dry. Of the 223 oil wells, 213 were drilled in connection with secondary-recovery operations. Of the 24 exploratory tests, 7 were commercial gas producers and 17 were dry. Of the 401 completions not drilled for gas storage or secondary oil recovery, 87 were dry - a ratio of one noncommercial well to every 4.6 wells drilled. The total footage drilled both shallow and deep, was 2,302,784 ft.

Exploratory tests totaled 24, resulting in the drilling of a total of 131,891 ft. of hole, or an average per well of 5,495 ft. Of the 24 exploratory tests, 7 were successful and 17 were dry, giving a success ratio of one in 2.4. The 7 successes consisted of 1 new gas field discovery and 6 new gas pools.

Oil pipe line runs totaled 6,160,387 barrels, a decrease of 5% over 1958 runs. The 1959 oil production was gathered by 7 pipe line companies. Sixty-eight thousand barrels of distillate was produced. Proven oil reserves were estimated at 113,858,000 barrels as of Dec. 31, 1959.

Gas produced totaled 118,862,000 MCF, compared with 104,974,000 MCF in 1958. Gas reserves were estimated at 1,051,972,000 MCF at the end of the year. The total reservoir capacity for storage of natural gas in Pennsylvania is 455,885,473 MCF.

More than 2,000,000 acres were leased during the year. Most of the leasing was done in the southwestern and northeastern sections of the state. There were 5,772 acres of state-owned land leased at a yearly rental of $3.21 to $45.63 per acre and $.04 MCF royalty. Nine million undeveloped acres are estimated to be under lease.

Seismic activity more than doubled since 1958. Operators have kept 4 seismic crews busy throughout the southwestern and northeastern parts of the state. More geological field parties have been active in 1959 than in the previous year. An airborne magnetometer survey of the Appalachian basin area is being flown. The detailed air survey will cover 121,500 sq. mi. and the aeromagnetic maps will be offered to oil and gas companies for purchase. Completion of the survey is scheduled for Nov. 1960.--Auth.

3-1362. Stevens, Curtis, ed. **HUGOTON EMBAYMENT-ANADARKO BASIN YEARBOOK, 1961 COVERING 1960: 96, 146 p., geol. structure maps, isopachs, National Petroleum Bibliography, Box 3586, Amarillo, Texas, approx. 250 refs.**

This volume contains geological structure maps and isopachs on 72 producing areas in the Texas Panhandle, western Oklahoma, SW. Kansas, and SE. Colorado. Also included are discovery well, geological, reservoir, and economic data on more than 200 oil and gas fields, the bulk of them discovered in 1960. These data are preceded by a summary of 1960 exploratory activity in the Amarillo-Hugoton province, a bibliography of literature and technical data for 1959 and 1960, and a special report on the Red Cave gas play in the Texas and Oklahoma panhandles. The previous yearbook was listed as Geo-Science Abstracts 2-1290.

3-1363. Biggs, Paul, and Ralph H. Espach. **PETROLEUM AND NATURAL GAS FIELDS IN WYOMING: U.S. Bur. Mines, Bull. 582, 538 p., 171 maps, 12 tables, 1960, 292 refs.**

Petroleum and natural gas are the most important mineral resources of Wyoming. This study contains individual reports on 271 oil and gas fields in Wyoming. The location of each field is given; and, where available, maps of the fields are included in the report. Brief comments are made on the geology of the fields, surface formations, and elevations. History of the discovery and development of each field is recorded, and the amounts of oil and gas produced in each are tabulated by years. The facilities by which the oil and gas are transported from the fields are mentioned.

The 418 analyses of crude-oil samples represent the largest collection of crude-oil characteristics, including S content, N content, and refractive index data, that have been published to date on Wyoming petroleum. Analyses of 183 natural gas and 334 oilfield-water samples are tabulated.

This bulletin replaces U.S. Bureau of Mines, Bull. 418, Petroleum and Natural-Gas Fields in Wyoming, published in 1941. Bull. 418, now out of print, contained 79 field descriptions and 106 crude-oil analyses. This report includes all the fields covered in the earlier publication, bringing that material up to date. The maps are intended to show only general structural conditions or structural features. Caution should be exercised in using these maps for other than general study.

Although the geologic basins of Wyoming are not emphasized in the report, it is shown that most of the oil produced in Wyoming was from the Big Horn, Wind River, and Powder River basins. Lesser amounts of oil were from the Bridger (formerly called Green River), Laramie-Hanna, and Wyoming portion of the Denver-Julesburg basins. Natural gas production has been largely from the Bridger and Wind River basins. Some gas has been found in all the geologic basins of Wyoming except its portion of the Denver-Julesburg basin.

Drilling for oil and gas in Wyoming has followed the same trends as found in other major oil-producing areas of the country. As early as 1870, small quantities of oil were recovered from seeps or springs near Casper, Evanston, and Moorcroft. Later, the "spring-pole" method was used when drilling a few hundred feet, then the "churn" or cable-tool drilling for a few thousand feet, and, finally, the rotary drilling up to 20,000 ft. The unit well No. 1 in the West Poison Spider field was completed in 1948, with the producing interval from 14,187 to 14,309 ft. For several months after its completion this oil well ranked as the world's deepest producing well.

Crude-oil analyses included in this bulletin indicate that the chemical-physical properties of the oils produced in Wyoming vary considerably. The terms "black" and "green" oils appear throughout the report. Black or heavy oils have low API gravities, high S contents, and usually low yields of gasoline. Green or light oils have high API gravities, little or no S content, and yield considerable gasoline. Fields, such as Grass Creek and Oregon basin fields, producing black oils have had erratic production over the years as shown in the table of oil produced by fields and by years. Considering the fields by a basin grouping, it is noted that the majority of the oil found in the Big Horn basin has been of the black oil type. Most of the oil found in the Powder River basin has been of the green or light oil type.--Auth. summ.

3-1364. Brant, Russell A., and Richard M. DeLong. **COAL RESOURCES OF OHIO: Ohio, Div.**

Geol. Survey, Bull. 59, 245 p., 22 figs. incl. maps, sec., graph, 38 tables, 1960, refs.

The present estimated original coal reserve of Ohio totals 46,488,251,000 short tons. This reserve is found in 24 coal beds in which the known or estimated thickness is 14 in. or greater (lower thickness limit of "minable" coal). The estimated coal reserve occurs in 32 counties located in eastern and southeastern Ohio.

Those Ohio counties which fringe the northern and western portions of the coal area have only one or part of one formation containing minable coal deposits. However, to the S. there are as many as 4 coal-bearing formations (Pottsville, Allegheny, Conemaugh, and Monongahela), each of which may contain several coal members of minable thickness. In the central part of the coal basin, along the Ohio River in Washington County and the surrounding area, the Washington and the Greene formations contain small amounts of coal.

By the reliability classification more than 27 billion tons is proven and probable. By thickness classification 60% of the total reserve is found in the greater-than-28 in. category. By geologic age, the Allegheny and Monongahela formations contain most of the estimated reserve, approximately 86.5%, or more than 40 billion tons. The Pennsylvanian rocks contain 96.7% of the estimated reserve, and the Permian rocks contain 3.3%. The most extensive reserve, according to the present estimate, is in the Lower Kittanning (No. 5) and the Middle Kittanning (No. 6) coal beds which contain 40% of the estimated coal reserve of Ohio.

The all-time coal production in Ohio is reported at slightly less than 2 billion tons. If the recovery rate was 50%, then 4 billion tons of coal have been mined or lost in mining. Remaining reserve is about 42 billion tons. The recoverable reserve at 50% recovery is 21 billion tons.--Auth.

3-1365. Denton, George H. COAL RESOURCES OF THE UPPER PART OF THE MONONGAHELA FORMATION AND THE DUNKARD GROUP IN OHIO: Ohio Div. Geol. Survey, Rept. Inv., no. 38, 50 p., 15 figs., 16 tables, 1960, 27 refs.

An estimated 3,902,396,000 short tons of original coal reserve of the upper Monongahela [Pennsylvanian] and Dunkard [Permian] strata is distributed principally in Belmont, Monroe, and Washington counties. The Monongahela coal beds contain an estimated original reserve of 2,511,668,000 short tons, distributed as follows:

Fishpot coal.....	440,746,000 tons
Uniontown (No. 10) coal.....	1,380,168,000 tons
Waynesburg (No. 11) coal.....	690,754,000 tons

The Dunkard coal beds contain an estimated 1,390,728,000 short tons, which is distributed as follows:

Waynesburg "A" (No. 11a) coal	490,686,000 tons
Washington (No. 12) coal	900,042,000 tons

Most chemical analyses of these coal beds reveal a high ash and S content and a correspondingly low B.t.u. content. Most of these coal beds are easily accessible and have been mined on a small scale for local use. Because of the general thinness and low heating value of the coal, increased utilization of these beds will probably await the development of highly efficient preparation plants or coal-burning equipment that can utilize low-grade coal. As the better quality and thicker coal beds are depleted, the upper Monongahela-Dunkard coals will play an increasingly important role as a future source of energy in Ohio.--Auth.

14. ENGINEERING GEOLOGY

3-1366. Hemstock, R.A. MUSKEG - A REVIEW OF ENGINEERING PROGRESS: Can. Mining & Metall. Bull., v. 53, no. 581, p. 668-673, 3 illus., 3 tables, Sept. 1960, 19 refs.

Simple classification systems are now being used which will describe adequately the surface vegetation, the topography, and the peat for any muskeg condition.

Good progress is being made in determining some of the mechanical properties of muskeg, and it is apparent that the science of soil mechanics will apply largely to these studies.

Correlation is also indicated between shear strength as determined by the shear vane tester and vehicle performance.

Several tracked vehicles are now available which perform well in muskeg, and advances in this field have come rapidly in the past few years. Testing is under way on the largest of all muskeg vehicles - the 35 ton Musk Ox. This vehicle will fill the last gap for the oil industry and will make possible the movement of large drilling rigs at any season of the year. --Auth.

3-1367. Legget, Robert F., and W.J. Eden. SOIL PROBLEMS IN MINING ON THE PRECAMBRIAN SHIELD: Engineering Jour., v. 43, no. 11, p. 81-87, 5 illus., table, Nov. 1960, 6 refs.

Soils encountered in mining operations on the Precambrian Shield are almost all glacial in origin, ranging from well-drained sand and gravel deposits to the silts and clays of glacial lakes. The character of typical glacial clays is described and the reason for their unusual properties, an artificially high natural moisture content, is explained. Failures of soils of this type at the Josephine and Beattie mines are summarized, followed by outlines of successful engineering operations involving the same soil types, including the draining of Steep Rock Lake for Fe mining purposes. A table lists soil problems in relation to mining, correlated with principal soil groups. A short bibliography on soil mechanics is included, the purpose of the paper being to introduce mining engineers to the aid that can be given to their mining operations by the application of soil mechanics.--R.F. Legget.

3-1368. U.S. Army, Corps of Engineers, Committee on Tidal Hydraulics. SOIL AS A FACTOR IN SHOALING PROCESSES, A LITERATURE REVIEW: Its: Tech. Bull. no. 4, 47 p., 6 figs. incl. graphs, June 1960, 81 refs.

This literature survey was made to assess, on the basis of available information, the probable influence of soil properties on the transport, deposition, and stability of shoal materials in estuaries.

Descriptions are presented of the physical and engineering characteristics of soil, particularly the

clay minerals, kaolinite, montmorillonite, and illite, which are carried in suspension and may be deposited in shoal areas. The various factors influencing the process of sedimentation are discussed; these include hydraulic factors, sediment type and concentration, salinity, temperature, pH, organic matter, industrial wastes, etc. Finally, available information is presented on the mode of deposition and physical characteristics of the sediment deposits.

The results of the literature survey show that the principal source of shoal materials is suspended, fine-grained soil material carried into an estuary by fresh-water streams. The suspended sediment tends to flocculate in the presence of salt water, forming aggregates which settle to the bottom and form shoals. The rate of settling is influenced primarily by the salinity of the water; temperature and turbulence of the water, and nature and concentration of the soil particles are of lesser importance.

The current flow pattern in an estuary controls the extent of shoaling. Sediment movements are controlled by the currents themselves, whereas the rate of sedimentation is influenced by turbulence and the extent of mixing of fresh and salt water. The fact that near the bottom of an estuary there is usually no net flow seaward indicates that sediments settling in this region are effectively retained in the estuary.

Sand deposited in shoals does not change in physical properties with time. Density is fairly high, but resistance to erosion is that of the individual particle. The properties of clays deposited in shoals can and do change with time. Initially they are light and fluffy, but they consolidate under further accumulation of material, increasing in density and strength. However, the consolidation process is slow, and in most accumulating deposits is never complete, resulting in a deposit that has only slight increases in density and strength below the first few feet. The erosion of clays is dependent upon the balance of erosive forces and the resistance at any point; usually they are considered highly resistant to erosion.--Auth.

3-1369. Genensky, Samuel Milton, and R. L. Loofbourow. GEOLOGICAL COVERING MATERIALS FOR DEEP UNDERGROUND INSTALLATIONS: RAND Corp., Research Memo. RM-2617, 56 p., 4 maps, 12 secs., Aug. 4, 1960, 27 refs. (not seen at AGI)

Examination of 12 geological configurations indicate that underground installations in competent rock may be protected from nuclear weapons blasts by overlying hard rock, broken rock, shale, uncompacted rock, or combinations of these rocks. Additional protection is provided by the "umbrella effect" of tunnels in the overlying rock.

Thick glacial ice in Alaska would attenuate and dissipate blast waves by its viscoplastic behavior and compactability and would afford protection to installations beneath it. In Minnesota installations in granite would be protected by up to 500 ft. of glacial till and shale, which can attenuate and alter high-energy explosive waves. Compaction of highly porous, thick diatomaceous beds in the Monterey and Sisquoc formations of Santa Barbara County, California, would provide protection for installations in the diatomaceous beds. Plastic flow would give additional protection at places. Protection from repeated attacks would be provided by 1,000 ft. of diatomite.

Installations located 50 ft. or more below existing mines would be protected by the "umbrella effect" where ore has been mined from 2 almost horizontal overlapping beds of large area and 500 ft. below ground; each bed has been thoroughly and randomly worked; a thick competent rock bed underlies the mine; no poisonous or flammable gases or objectionable amounts of water are present; ground could be bought or leased at reasonable price. Possible areas for such installations are in the Keweenaw Peninsula, Michigan. Broken uncompacted rock 800 ft. thick overlying an Fe mine near Cornwall, Pennsylvania, provides a similar protective action.

A thick cover of cellular rocks might provide protection in such areas as the Vermillion Cliffs and Grand Wash, Arizona, Barberton, Ohio, and the Book Cliffs near Rifle, Colorado. Where installations could be located in cellular rocks underneath mines, as at Morgantown, West Virginia, the "umbrella effect" would eliminate the high-frequency waves.

Near McConnelsville, Ohio, installations in the Maxville limestone would be protected by thin-bedded cellular and plastic rocks in the overlying Pottsville, Allegheny, Conemaugh, and Monongahela formations. The 1,000 to 2,000 interfaces between rocks of different physical properties should appreciably attenuate high-frequency waves. Similar effects should be obtained from Pleistocene and Pennsylvanian rocks near Peoria, Illinois.

Theoretical and experimental investigations undertaken to check the deductions in this report should be directed toward comparison of various geological arrangements, attenuating effects of rock and soil combinations, and destructive effects of blast waves at depth.--R. Van Horn.

3-1370. Symposium on Highway Engineering Geology, 11th, Tallahassee, Florida, 1960. PROCEEDINGS. Edited by William F. Tanner: 119 p., illus., maps, secs., profiles, diags., Tallahassee, Florida Geological Survey, Sept. 1960, refs.

This meeting was held at Florida State University, Tallahassee, on Feb. 26, 1960. The 8 papers presented are abstracted below.

Vernon, Robert O.. The Geological Distribution of Highway Base Course Material and Aggregate in Florida, p. 1-8.

Florida roadbeds seldom fail as a result of freezing or thawing, but rather because of heavy, concentrated rainfall. Soft clays and muds, mucks and peats, and deep sink holes present special problems; where soft materials are not too thick, they are excavated and replaced by sand. Base courses, generally 6 to 10 in. thick, are commonly crushed and graded limestone, with local sources of sand-clay mix, shell and marl being used at a few places. The Ocala group furnished the best limestones in the state. All base course materials must pass strict tests concerning amount of trash, plasticity, permeability, and uniformity.

Crystal River, Williston and Inglis formations, within the Ocala group, are extensively mined. In southern Florida, the Miami oölite is used. Course aggregate is scarce. Silica gravel, stone, or furnace slag may be used, provided it passes abrasion and chemical tests. Slag is obtained from Birmingham, Alabama, and stone consists of crushed fragments of the harder, more dense limestones within Florida.

Mather, Bryant. Petrology of Concrete Aggregate, p. 9-21.

Up until recently, aggregates were defined as "inert" materials. In the 1920's G.F. Laughlin was able to establish a correlation between deterioration of concrete and the use therein of aggregates having undesirable properties. About 1940, T.E. Stanton discovered what is now known as the "alkali-aggregate reaction." As a result of this and later work, we can no longer speak of aggregates as inert material.

Policy of the U.S. Army, Corps of Engineers, requires petrographic study of samples from each aggregate source which might be used in a proposed construction project. Because of the wide variability of materials, evaluations must be made on a statistical basis, and blanket approvals, or disapprovals (such as "granite is good," or "shale is bad") cannot be made. [In alkali-aggregate reaction 1) the aggregate must be reactive, 2) alkali must be present, and 3) moisture must be present] for damage to occur. As long as the reaction takes place in a solution saturated with calcium hydroxide, a limited-swelling gel is produced, and no harmful reaction follows.

Additional work needs to be done on the behavior of aggregate particles during freezing and thawing, heating and cooling, wetting and drying, and loading and unloading of the concrete.

Carey, W.N., Jr., and W.J. Schmidt. THE AASHO Road Test: a Progress Report, p. 23-34.

The AASHO Road Test at Ottawa, Illinois, is a statistically designed research project with the major objective of determining significant relationships between the performance of highway pavements and the loads applied to them. Both flexible-type and rigid-type pavement are used, and various structural designs have been incorporated. There are 836 test sections, in 6 different highway loops, 5 of which are subjected to controlled tests consisting of trucks and tractor-trailer combinations (the sixth is used for special tests). All vehicles operated in any one lane, in any one loop, apply identical loads to the pavement.

All possible combinations of the selected slab thicknesses, base material thicknesses, and pavement loading are used in what is known as a complete factorial experiment. This is an extremely strong design, lending itself to sound analyses. In addition, location of test sections within any given loop was made on a random basis, despite the greater difficulties of construction.

The 7 variables are pavement type, surfacing thickness, base thickness, subbase thickness, reinforcing or nonreinforcing in rigid-type pavement, axle load, and axle arrangement.

By Jan. 1, 1960, the test fleet of 78 vehicles had amassed a record of about 6 million mi. of operation and 400,000 applications of a specific axle load on all pavement sections remaining in test. At that time 48 more vehicles were purchased and put in test. Meanwhile, a serviceability rating scheme has been developed, so that an index, providing a "picture" of the relative performance of each section, can be plotted against time.

Michener, P.Z. Preliminary Sub-Surface Investigation of the Chesapeake Bay Crossing, p. 35-54.

The project consists of a bridge-tunnel crossing of the lower Chesapeake Bay between Chesapeake Beach, near Norfolk, Virginia, and the southern tip of the peninsula on the eastern shore of Virginia (Cape Charles). The estimated cost is about $144,000,000, the total length about 24 mi., of which 18 mi. is over open water.

The major part of the project length will consist of trestle built over water 20 to 30 ft. deep, in areas where there are no established navigation requirements. Tunnels are to be constructed under each of the 2 major ship channels, with a total length of 11,864 ft. Tunnel structures will consist of prefabricated concrete tubes, 37 ft. in diameter and 300 ft. long, sunk into place and joined in a prepared trench and covered with selected backfill material. The ends of the tunnels will be founded on artificial islands, the cores of which will be built of sand dredged from the adjacent bottom. In addition, a bridge will provide local clearance for fishing fleets.

Geological information showed that basement rock is deeper than 2,000 ft. The DM Raydist phase comparison system was used to locate drilling sites, with an accuracy of 1 in 5,000. Actual drilling was done from towers resting on the bay floor. A sonar reflection survey was made, to determine lateral continuity of various layers, between drill holes. Tertiary deposits, suitable for supporting pilings, were thus delineated. The subsurface field program, completed in less than 2 months, provided 4,700 ft. of samples from 26 holes. Approximately 100 additional borings will be made to provide final foundation information.

Fritz, Axel M., Jr. The MD Engineering Seismograph and its Application to Highway Engineering, p. 55-65.

The MD engineering seismograph can be used to determine the thickness of a surface layer, depth to a contact, dip, rock type (i.e., gravel, clay, bedrock), and rippability of materials.

Sound waves from a sledgehammer blow (or explosive) travel through the subsurface along various paths, some direct to the receiver and others through any high-velocity layer which may be present. The MD seismograph measures the time of travel of the fastest wave, regardless of its path. Readings taken at various hammer-receiver spacings commonly plot as 2 (or more) line segments each of which has a distinctive slope. The slope of the first segment yields the velocity of the wave in the surface layer (perhaps the soil), the slope of the second segment yields the velocity in the second layer, and the depth to the contact is obtained from the intersection of the 2 lines. Materials are identified from their characteristic velocities.

Travel times are read directly from a series of small lights, to divisions as small as one quarter of a millisecond.

The complete unit is about the size and weight of a portable typewriter. Depth of investigation depends on whether explosive or hammer is used, and in the case of the latter on the weight of the hammer.

Bruun, Per. Beach Erosion and Protection in Florida, p. 67-86.

Florida has about 1,300 mi. of shoreline, including about 800 mi. of sandy beach. Natural shoreline erosion in the state is about 1 ft. per year, perhaps in part due to the recent sea-level rise of 3 to 4 in. (1930-1950). The increase in erosion in heavily populated areas (up to 30 ft. per year) is due to man's interference with the natural shore regime. The greatest erosion is the result of improved inlets, which work as barriers to the natural littoral drift. The net loss on the most important 200 mi. of beach in the state is about 15,000,000 cu. yd. per year.

Coastal protection measures which have been used or planned in the state include seawalls (both vertical and sloping), groins, dikes, and artificial nourishment. The latter has, to date, depended largely on sand dredged or dug farther inland; this source is

obviously quite limited. In the near future it will be necessary to obtain supplies, for artificial nourishment, from the sea floor.

A coastal zoning plan, for financing coastal protection measures, is suggested.

Lynch, S. A., and Paul Weaver. Pavement Disruption by Recent Earth Movements, p. 87-108.

This discussion concerns earth movements in the Texas coastal plain causing disruption of manmade surface structures. Most of these involve subsidence. Two well-known examples of subsidence are Mexico City (21 ft. difference in 58 years; 11.8 in. per year in 1954) and Long Beach, California (26 ft. between 1937 and 1958). Most of the Texas cases amount to only a few inches, but this may lead to a need for protection or reconstruction of pavements, pipelines, and buildings.

Regional tilting, such as in the Galveston region, may affect freeboard of docks, but does not now seem to be a hazard to roads. Tectonic adjustments (down-to-the-coast faulting) produces a steepening of the gentle surface slopes; the Hitchcock fault, in Galveston County, has had a movement of about 14 in. in the past 15 years, associated with pavement breakage and misalignment of railway tracks. Landslide subsidence, near stream banks, has been reported, with related damage to structures. Loading effects may be due to consolidation of the uppermost layers as a result of building, irrigation flooding, or ore-bin storage (i.e., sulfur). Mining subsidence results from the removal of solid or fluid minerals from underground. Collapse due to mining has taken place in connection with removal of S, salt, oil, and water. Water removal, by plant transpiration, has resulted in shattering curbs and street slabs in several locations. Many examples are given.

Radzikowski, H. A. Rock and Earth in the Highway Program, p. 109-119.

When the present long-range highway program is completed, some 20 million cu. yd. of rock and earth will have been removed each working day. How efficiently and economically this is done depends in part on the geologists involved. In 1925 the average bid price for common excavation on highway work was 39 cents per cu. yd.; in 1950 and in 1959 it was 38 cents. This stability in price is due partly to increasing mechanization, but also in part to increased geological knowledge about the material to be moved, and hence the better matching of machinery and tasks.

New techniques now available include aerial surveys, the use of the tellurometer for ground control, and electronic computers to process and analyze survey data. Aerial mosaics permit planning without the danger of sky-rocketing real estate prices which follow ground crews. Drainage area outlines, cross-section data, and estimates of earthwork can be made by computer techniques from aerial survey data.

A new nuclear instrument, using radium-D Be as a source, permits rapid determination of moisture and density of highway embankments. Other new equipment available for subsurface work includes a resistivity device and a seismic instrument. The location of suitable material for highway construction is speeded by the use of photo interpretation procedures.--W. F. Tanner.

3-1371. DAM DISASTER TRACED: New York Times, v. 110, no. 37,649, p. 30, col. 5, Feb. 21, 1961.

The ultimate blame for failure of the Malpasset Dam, France, which had been constructed on a faulty rock base, must be laid to the persons responsible for the preliminary geologic studies; they failed to allocate sufficient funds for an adequate survey of conditions at the site. The dam failed on Dec. 2, 1959, killing 400 persons and nearly wiping out the Mediterranean town of Frejus.--M. Russell.

3-1372. Jacob, C. E. GROUNDWATER AND DRAINAGE OF YUMA VALLEY AND CONTIGUOUS AREAS: 50 p., illus., maps, charts, sec., profiles, graphs, Yuma County Water Users' Association, P.O. Box 708, Yuma, Arizona, Oct. 1960, 62 refs.; 9 appendices and 2 supplements separately bound (not seen).

Deep percolation from the irrigation of the Yuma Auxiliary Project on the Yuma Mesa, starting in 1925, and more recently from the irrigation of the Mesa Division of the Gila Project, starting in 1947, have caused a strong ground-water underflow to Yuma Valley and have given rise to actual or potential artesian-pressure conditions under that valley. By 1945 the aggregate underflow had totaled 50,000 acre-ft. and by 1959 about 500,000 acre-ft. The rate of underflow has risen sharply in recent years and reached 69,000 acre-ft. in 1959. It is estimated that if the present input to the ground-water mounds under Yuma Mesa levels off at its present value the underflow to Yuma Valley may in a few years level off at 83,000 acre-ft. per year. If the irrigated acreage on the mesa is expanded to its allowable upper limit, as much as 100,000 acre-ft. per year of underflow may enter Yuma Valley from Yuma Mesa in the future.

The artesian pressure has been kept under control in the past, first by 9 shallow drainage wells installed by the U.S. Bureau of Reclamation starting in 1947 and more recently by the 9 deep drainage wells which replaced them and which were constructed between 1954 and 1958. To the end of 1959 about 400,000 acre-ft. of foreign drainage water had been pumped by these wells. The aggregate cost has been about $1.6 million or about $4 per acre-ft.

This water has been emptied into the surface drainage system of the valley project, placing an added burden thereon and increasing the cost of maintaining the drains and de-mossing them, etc. Also the cost of operating the boundary pumping plant at the Mexican International Boundary, through which the water must pass, has been increased. It is regarded as highly desirable that this foreign drainage water no longer be emptied into the surface drainage system but that it be conveyed directly to the Colorado River and be emptied into the "limitrophe section" of that river between the 2 international boundaries.

To accomplish this purpose it is recommended that 2 reinforced concrete pipelines be built across the valley project and be interconnected with the existing 9 and 3 additional deep drainage wells. The northern pipeline would be 72 in. in diameter and would convey about 80 c.f.s. and the southern pipeline 60 in. in diameter, conveying about 60 c.f.s. The cost of these pipelines and interconnecting feeder lines and additional wells is estimated at $6.065 million. The annual capital cost, assuming the money were borrowed at 2 1/2% for 100 years, would be roughly $165,000. Since installation of the deep drainage wells the cost of pumping those wells has been about $1.34 per acre-ft. The cost of pumping the water from the wells and through the pipelines to the Colorado River would be about $3.90 per acre-ft., of which $1.66 would be capital cost on the pipe-

lines, assuming that the pipelines convey 100,000 acre-ft. per year. The additional power cost required to pump the water through the pipeline would be about $.73 per acre-ft. and the cost of operating and maintaining the pipeline about $.17 per acre-ft. This total of $3.90 per acre-ft. is slightly less than what it has cost YCWUA to handle the foreign water in their own system.

These pipelines will provide a controlled though flexible system by means of which foreign drainage water can be moved across the valley to the Colorado River and be credited to the United States on the Mexican Treaty. The 50,000 acre-ft. of water or more per year now escaping to the Colorado River or under the Colorado River to Mexico could be diverted, as could also the southward flow across the Mexican border. This could be accomplished by means of an augmentation of the proposed new drainage system, adding a third barrel crossing the valley still farther S., with tributary drainage wells as needed.--Auth.

3-1373. U.S. Army, Corps of Engineers. PRESQUE ISLE PENINSULA, ERIE, PENNSYLVANIA, BEACH EROSION CONTROL STUDY: U.S. 86th Cong., 2d sess., 1960, House Document no. 397, 62 p., illus., maps, graph, profiles, 6 tables, 1960.

A study made in cooperation with the Commonwealth of Pennsylvania to determine the rates of loss and movement of the sand fill, to estimate the nourishment requirements of the existing cooperative shore protection project, constructed in 1955-1956, and to determine its eligibility for federal participation.

The peninsula, located on the S. shore of Lake Erie, is a compound recurved sandspit projecting a maximum distance of about 2.5 mi. from an otherwise straight mainland shore. It has a lake shoreline of over 6 mi., exposed to wave attack from the SW. through N. to NE. The greater frequency and severity of storms from the westerly quadrant and the greater fetch in that direction cause a predominant eastward movement of littoral drift. The supply of beach materials from bluffs and streams W. of the spit has been insufficient to replace material eroded from the neck of the spit. Recession of the shoreline has been greatest at the root of the peninsula, gradually decreasing to a nodal point about two-thirds of the length of the peninsula from the root, from which point accretion has occurred as the eroded material was deposited in that area. On several occasions the narrow neck of the peninsula was breached by storm wave action. The earlier breaches were closed by natural processes. The federal government closed a breach in 1920-1922 and since has built seawalls and bulkheads on the lake shore of the neck to prevent the loss of protection it affords to Erie harbor. Increased erosion has occurred to the NE., necessitating more protection.

The report deals with the geomorphology of the area and analyses the problem in terms of the shore processes. A plan of protection and an economic analysis are set forth. It is estimated that maximum rate of replenishment required will be approximately 154,000 cu. yd. annually at an estimated total cost of $168,000. Annual surveys are recommended, beginning in 1960 and continuing over a 5-year period to determine condition of the beach and offshore areas and the need for replenishment.--A.C. Sangree.

3-1374. U.S. Army, Corps of Engineers. GULF SHORE OF BOLIVAR PENINSULA IN THE VICINITY OF ROLLOVER FISH PASS, TEXAS: U.S. 86th Cong., 2d sess., 1959, House Document no. 286, 30 p., 4 charts, secs., 4 tables, U.S. Govt. Print. Off., 1959.

The report presents the findings of a cooperative beach erosion control study to determine the best method of shore erosion control on the Gulf shore in the vicinity of Rollover, Texas, and the best way to stabilize the Rollover Fish Pass constructed by the State Game and Fish Commission of Texas.

It is found that there is extensive active erosion along the Gulf shore between High Island and a point 7 mi. E. of Galveston entrance that results in a deficiency of beach materials of about 200,000 cu. yd. of material annually, and further, that construction of the fish pass has resulted in an increase in the deficiency of about 18,000 cu. yd. annually. The most satisfactory method of controlling the shore erosion would be by replenishment of the beach materials. This could be done by placing 18,000 cu. yd. annually, obtained from the pass or adjacent bay areas to replenish the loss caused by the pass, or to place 200,000 cu. yd. obtained from Rollover Bay to alleviate all erosion SW. of the pass.

The excessively high current velocities in the restricted pass would require that the pass be stabilized by continuous bulkheads along both sides of the pass and suitable sills to control the channel to a depth of 6 ft. and width of 75 ft. at the bridge and Gulf end of the bulkhead. The sill and bulkhead should be adequately protected with riprap.

Investigation shows that except for the rights-of-way for the fish pass and the highway there is no federal or nonfederal public land in the study area that is subject to erosion. It is concluded that no participation in the cost of erosion control of the Gulf shore or in the stabilization of the Rollover Fish Pass by the United States is warranted at this time.--Auth. syllabus.

15. MISCELLANEOUS

3-1375. Ham, William E., and Neville M. Curtis, Jr. COMMON MINERALS, ROCKS, AND FOSSILS OF OKLAHOMA: Oklahoma Geol. Survey, Guide Book 10, 28 p., illus., geol. map, 2 tables, 1960.

The collection of 20 minerals, rocks, and fossils described in this booklet is intended for use by students in the secondary schools of Oklahoma. As all specimens are from Oklahoma, the collection serves to acquaint the student with some of the geological materials that occur in the state. Minerals described are: milky quartz, chert, calcite, selenite, magnetite, hematite, limonite, galena, sand-barite rosettes. Rocks are: red granite, rhyolite, sandstone, limestone, shale, coal, rock gypsum, quartzite. Fossils are: brachiopods, pelecypods, fossil wood.

3-1376. International Science Foundation. SCIENTIFIC RESOURCES OF THE SAN FRANCISCO BAY AREA: 3d ed., 108 p., map, The Author, World Trade Center, San Francisco 11, California, 1960.

The third edition of this biennial handbook and directory. It contains the following information: 1) outline of Bay Area research facilities (alphabetically

by subject and including cartography, climatology, crystallography, earthquake design, geochemistry, geodesy, geography, geology, geomorphology, geophysics, micropaleontology, mineral engineering, mineralogy, mining engineering, oceanography, paleontology, petrography, petroleum engineering, petrology, photogrammetry, seismology, soil mechanics, soil science, surveying and mapping, volcanology, and other subjects related to the geological sciences); 2) universities and colleges; 3) scientific institutions and foundations; 4) scientific and engineering societies; 5) consulting engineers; 6) industrial research facilities; 7) trade associations engaged in research; 8) federal, state, county, and municipal research facilities; 9) scientific and technical periodicals. For each institution information is given on departments, current research projects or activities, laboratory and library facilities, special collections, specialized services offered, number on staff.--A.C. Sangree.

3-1377. National Advisory Committee on Research in the Geological Sciences, Ottawa. TENTH ANNUAL REPORT 1959-60 (INCLUDING SURVEY OF CURRENT RESEARCH IN THE GEOLOGICAL SCIENCES IN CANADA, 1959-60): 104, 100 p., 3 tables, pub. Jan. 1961, refs.

The first part of this report gives a summary of the work of the Committee during the period Sept. 1, 1959 to Aug. 31, 1960. This is followed by reports of the subcommittees covering the different fields of the geological sciences. These record developments in 1959-1960 and suggest further problems for study.

The second part of the report includes the annual survey of current geological research in Canada. This records information on research by the universities, federal and provincial departments of mines, research councils, and foundations between June 1959 and May 1960.--From introd.

3-1378. North Dakota, Geological Survey. THIRTY-FIRST BIENNIAL REPORT...[JULY 1, 1958 TO JUNE 30, 1960], by Wilson M. Laird: 18 p., graphs, 2 tables, 1960.

3-1379. South Dakota, State Geological Survey. THE BIENNIAL REPORT OF THE STATE GEOLOGIST FOR FISCAL YEARS 1959 AND 1960, by Allen F. Agnew: 71 p., illus., maps, tables, 1960.

3-1380. Colwell, Robert N. SOME USES OF INFRARED AERIAL PHOTOGRAPHY IN THE MANAGEMENT OF WILDLAND AREAS: Photogramm. Eng., v. 26, no. 5, p. 774-785, 11 illus., diag., 2 graphs, Dec. 1960, 5 refs.

Portions of this paper are of definite geologic interest. Properties of infrared sensitive films and the relative merits of infrared and panchromatic film for various purposes are discussed. The purposes discussed include the delineation of rock outcrop in soil-rock areas and the identification and delineation of water bodies. Methods for selecting film-filter combinations to provide maximum image contrast between rock outcrop and surrounding soil are presented.--J.R. Van Lopik.

3-1381. Frost, Robert E. THE PROGRAM OF MULTIBAND SENSING RESEARCH AT THE U.S. ARMY SNOW, ICE AND PERMAFROST RESEARCH ESTABLISHMENT: Photogramm. Eng., v. 26, no. 5, p. 786-792, Dec. 1960, 3 refs.

Multiband sensing consists of detecting, defining, resolving, recording, and analyzing distant objects by means of single or multiple imaging devices sensitive to the electromagnetic radiations, either inherent or reflected, emanating from these objects. The sensing of the emanations is not limited to a narrow frequency band, but encompasses the range from very short wavelengths to long-wave radio (including gamma rays, X-rays, ultraviolet, visible light, infrared, and various long-wave radio frequencies). The research approach to aerial sensing employed by SIPRE includes: 1) determination of those portions of the electromagnetic spectrum from which maximum informational return can be expected within practical instrumental limitations; 2) determination of what systems are available utilizing the maximum information wave band zones; 3) determination of field and laboratory reflectance spectra of surfaces (soils, rocks, materials, vegetation, ice, snow, etc.) 4) development of research methods for laboratory study and completely coordinated and integrated field and aerial operations; 5) determination and evaluation of factors which affect creation of images; 6) development of analytical techniques, with measured reliability and defined limitations, for extracting useful information from aerial images; and 7) determination of the application of developed methods and techniques to solving problems of military, engineering, or scientific significance.

The organizational structure needed for research of this type and personnel requirements in the fields of earth science, engineering, and technology are discussed. Specific projects are described.--J.R. Van Lopik.

AUTHOR INDEX

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